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THE USE OF EXHAUST STEAM.

It is often thought that where exhaust steam can be used for any purposes for which steam must otherwise be generated it will pay to so use it at the expense of low economy in the engine, due to the impossibility of condensing or even exhausting at atmospheric pressure. Whether this is the case or not depends on several considerations. In another column may be found a reprint of a paper by Dr. Louis Bell, in which he advocates the use of high economy engines and the separate generation of low pressure steam for use in place of exhaust steam for heating purposes. In the case which he has assumed to illustrate the advantages of this method, his argument of course is correct, as he assumes that only about 16 per cent. of the steam exhausted is made use of for heating purposes, the other 84 per cent. being blown away. If, however, all the exhaust steam is used for heating purposes, the case is quite different, the saving with engines of any steam consumption whatever over high economy condensing engines being practically all the heat given to the condensers.

The most frequent application of this case in electrical work is the use of exhaust steam for heating purposes in buildings lighted by isolated plants. In this case, if all the steam exhausted is used for heating purposes, there is really no expense whatever for fuel chargeable to the electric lighting account, every particle of the heat given to the steam in the boilers going into the building. Whatever heat is taken from the steam in the engines is either radiated in the engine room, where it can presumably be made to do useful heating, or transmitted into the electrical circuits, and thereby distributed and finally evolved as heat again inside the building. If the lighting system were shut down, exactly as many pounds of coal would have to be burned to heat the building. On the other hand, in summer when no steam heat is necessary, every pound of coal burned must, of course, be charged against the lighting account. In large office buildings, little used after 6 P. M., where the lighting load is almost negligible in the summer time, but comparatively heavy in the winter, this reduces the cost of fuel for the lighting to a very nominal sum and permits the use of engines of very low economy without appreciable increase of coal consumption. It has become customary on this account to install single-cylinder non-condensing engines with a rather low boiler pressure in all isolated plant work, but care should be taken, especially in the case of hotels and buildings where a considerable night load exists the year round, to obtain a higher engine economy in the summer season.

In the case of central stations selling exhaust steam for heating or other purposes, still other considerations come in. The leakage, and especially the condensation in the exhaust steam distribution system, is often greater than estimated, and may exceed the useful condensation at the points where heat is desired. If it were not for this it would undoubtedly be good engineering to sell all the exhaust steam possible, as it would practically mean a clear saving of all the heat exhausted and given to the condenser, beside the advantage obtained by the lower attendance charges of the central station boiler room over those of isolated steam-heating plants.

ELECTRIC PERCUSSION DRILLS.

The application of electric power to the operation of drills, acting by means of a succession of strokes, differs quite radically from other uses of electric currents. The rotary motion of an ordinary motor cannot be simply adapted to this work, the most obvious method of accomplishing it being by the use of a plunger intermittently attracted or repelled by one or more solenoids. Early drills of this type were actuated by direct current applied to two solenoids, with a switching device so arranged as to energize the upper solenoid when the drill was at the lower end of its stroke, and vice versa. The switching devices, especially in wet, muddy locations where such drills were used, naturally gave considerable trouble, and in most modern drills all contact devices are removed to the generators. Naturally the oscillatory character of alternating currents has been considered of value in this connection, and attempts have been made to work drills by alternating currents without any make and break devices whatever.

Such drills become analogous to synchronous alternating motors, and many of the laws of the latter apply to the drills, one in particular being the law that for best efficiency the back E. M. F. wave of the drill should resemble as nearly as possible in form the impressed E. M. F. wave of the generator, and to avoid wattless currents should be exactly opposed to it in phase. The simplest method of working such drills that would occur on first thought is the combination of a solenoid, alternating currents in the same, a plunger arranged to be drawn into the solenoid and a restoring spring to draw it out again. Obviously this would give a complete oscillation of the plunger for every alternation of the current, every half wave of the current drawing the plunger in and the spring drawing it out again as the current passes through the zero value. The back E. M. F. wave would, therefore, have a frequency twice as great as that of the impressed E. M. F., giving naturally very unsatisfactory results. An ingenious modification whereby this disadvantage is overcome is obtained in the drill described in another column. Here two solenoids are used, supplied alternately by the positive and negative waves of an alternating current, the switching from one solenoid to the other being effected on the alternating current generator by a rectifying device, which also serves for compounding the field coils. Sparking at the rectifier can be avoided by adjusting it to switch the circuit at the instant of zero current.

Another method which suggests itself for accomplishing the same result is the use of two solenoids, respectively supplied from the two circuits of a two-phase generator. When one solenoid is exercising its greatest attractive action on the plunger, the other solenoid is dead, and vice versa. A little consideration will show, however, that in this case the plunger will make one complete up-and-down stroke for each alternation of the current, thus giving a back E. M. F. wave with twice the frequency of the impressed wave, rendering the action very inefficient. Still another method which promises good results is the use of both direct and alternating current in the drill, the direct current being used to excite the plunger or magnetize it in one fixed direction, so that when placed in an alternating field it will be oscillated up and down, due to the resultant action of the two magnetizations. Neither the direct nor alternating solenoids need move with the plunger, the construction being possible on the lines of an inductor alternator which the machine virtually becomes, the oscillating plunger serving to thread the lines of force set up by the exciting coil, first through one coil of the alternating circuit and then through the other, as does the rotor of an inductor machine. Obviously, this does away with all make and break devices whatever, and it is possible that, as with the inductor motor, the power factor could be rendered very nearly unity by the proper adjustment of the exciting current.

CURRENT CONVERSION METHODS.

In modern practice the necessity frequently arises for the conversion of alternating into direct current or vice versa, the methods employed being extremely interesting and ingenious. In the great majority of cases the desired transformation is from alternating current to direct, as in the case of railways fed fom distant sources of power, or where the extent of the lines renders some departure from the simple feeder system desirable. Advantage may thus be taken of the capacity of alternating currents for long distance transmission, to the great saving of copper in feeders and lines. To effect the transformation of the one variety of current into the other a number of methods have been attempted, comprising simple commutation, as in the rectifiers of Ferranti and others; motor generators, both of the two-armature and one-armature types; electrolytic differentiation of the alternating current and the rotary transformer.

The rectifier or commutator has met with but limited use, and seems available only for small currents, and upon circuits with unvarying time constants. In England machines of this class appear to have given excellent service in rectifying current for series arc lighting, although the experience so far attained has been rather limited. The main difficulty with them is the savage sparking necessarily produced if any variation of the lag occurs. The expense and crudity, as well as the low efficiency, of motor generators has prevented the very widespread use of these machines and left the field practically to the single-winding rotary transformer.

ELECTRICITY AND THE MYSTERIOUS.

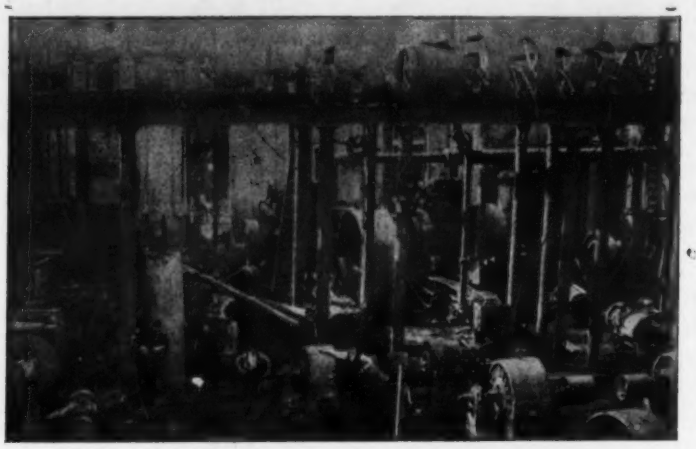
The general comprehension of electrical phenomena which exists in the lay mind is rapidly becoming greater with the constantly increasing use of electrical apparatus in everyday work. There exists still, however, a tendency to ascribe nearly everything that is mysterious or unaccountable to electricity. Nearly every fire whose origin is unaccounted for is laid to electric wires, although in all probability gas is a much more dangerous incendiary than electric current, as now used. The daily papers, realizing this peculiarity of the public mind, cater to it by attempting to bring in electrical causes for everything not obviously explainable on other grounds. The recent destruction of the battleship Maine by an explosion, the cause of which is unknown, has given ample opportunity for many able theorists in the electrical field. One paper states that the explosion was due to the short-circuiting of a dynamo, and another that it was due to the "explosion of the boiler of the dynamo machine." Many hypothetical causes have been evolved tending to show how the damage might have been inflicted by interested persons, by means of wonderfully contrived electrical devices. The electric detonator and push-button, alleged to accompany it, have received great prominence, while the time fuse and percussion cap have been neglected.

Among the changes which modern industrial advances have made possible in the art of warfare, very few can be ascribed to the tremendous strides in the electrical arts. In actual warfare electric power is of service, of course, in a limited way on shipboard, and the telephone and telegraph render rapid communication easy, but electricity, in spite of its latent powers, has not been found directly adaptable as a destroying agent. Notoriety seekers have proposed streams of water differing from the earth by a dangerous difference of potential and other similar impracticable schemes, but the fact remains that electricity is much more a power for peace than for war, its applications to the latter purpose being negligible compared with those to the former.

The System of the Brush Electric Company, of Baltimore.

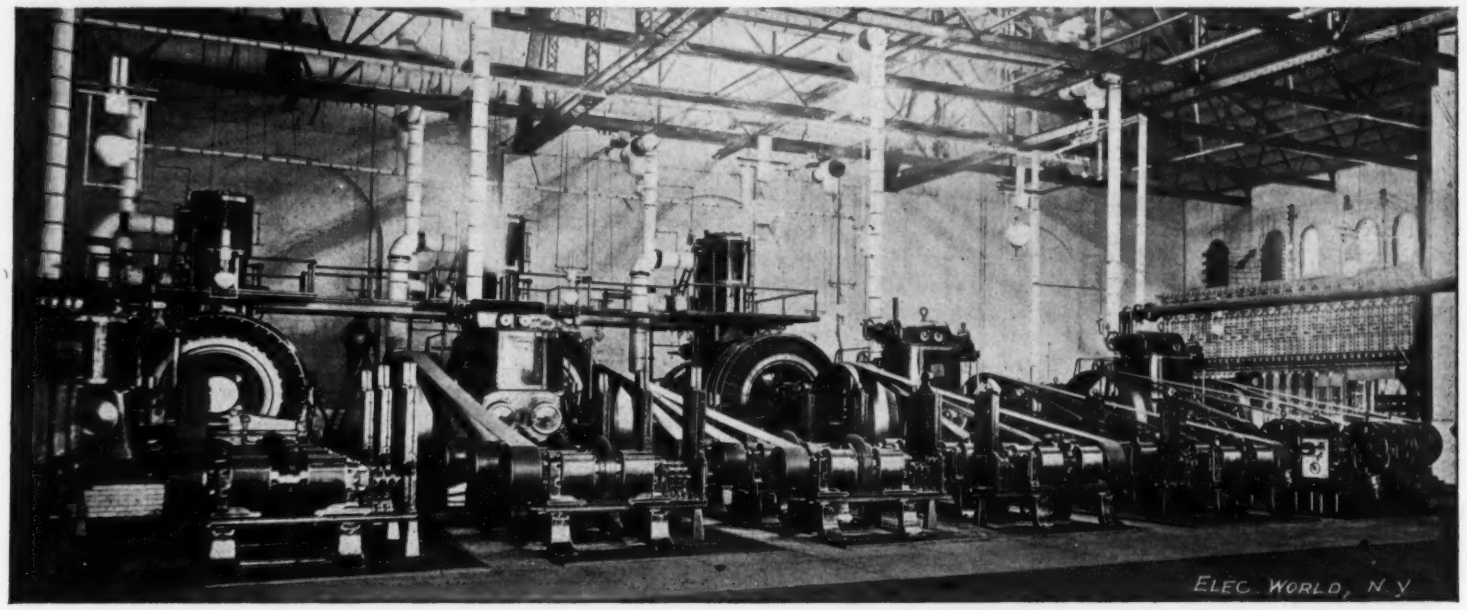
In the year 1881 the Brush Electric Company, of Baltimore City, Md., started supplying current for general illumination purposes from a small station on East Monument Street. The station was repeatedly enlarged and extended, the load being mainly that of Brush series arc lights for street illumination, until on the 13th day of October, 1893, the station, with its miscellaneous apparatus, was destroyed by fire. When rebuilt the system was modernized and brought strictly up to date, so that now the company has one of the most complete and systematically arranged central stations in the country, supplying a load of 1600 arc lights and 35,000 incandescent lights, and motors aggregating 400 horse-power.

The boiler and engine houses are of fireproof construction, fitted with steel trussed roofs capable of supporting at any point extremely heavy weights in case of repairs to the machinery. The boiler house is supplied with two stacks, one of brick, 10 feet in internal diameter, 150 feet high, and one of iron, 8 feet in diameter, of the same height. The boiler equipment comprises six 500-hp upright water-tube Climax boilers, made by the Clonbrock Steam Boiler Company. The coal is brought directly into the fire-room by freight cars, from which it is dumped into a basement coal storage bin, an elevator serving to bring it up to the boiler room floor. Above the boiler house there is an iron coal bunker, with a capacity of 1500 tons, and this will be fitted with coal conveying apparatus in the near future for handling the coal from the cellar to the overhead bunker.



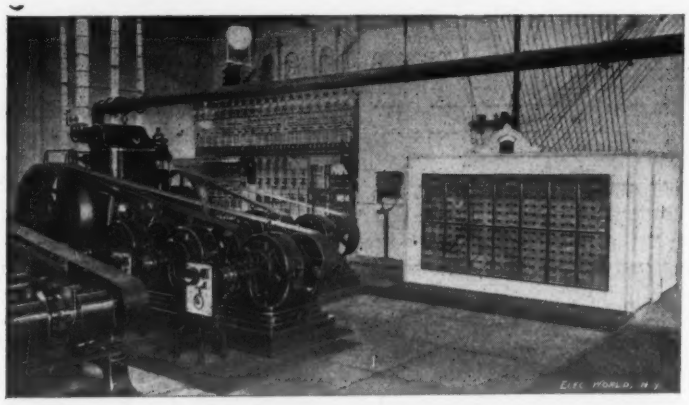
VIEW OF STATION AFTER 1893 FIRE.

Under the engines and dynamos four subways run the whole width of the station. Two of these carry all the exhaust, sewage and drainage pipes, while the other two carry the main leads from the machines to the switchboard. The floors of both the basement and engine room proper are of cement.



GENERAL VIEW OF MACHINE ROOM.

Water is fed to the boilers by two large Knowles pumps, being passed through four 1000-hp Berryman feed-water heaters, which the water leaves at a temperature of over 200°, the heat being supplied by the exhaust steam.



ARC MACHINES AND SWITCHBOARD.

The engine equipment comprises three 1000-hp Westinghouse vertical engines of the World's Fair type, space being left for a fourth unit of the same size, which will probably be installed during the present year. These engines run at a speed of 205 revolutions per minute. There are also six 350-hp Westinghouse two-cylinder enclosed engines belted to arc-light and power-supply generators.

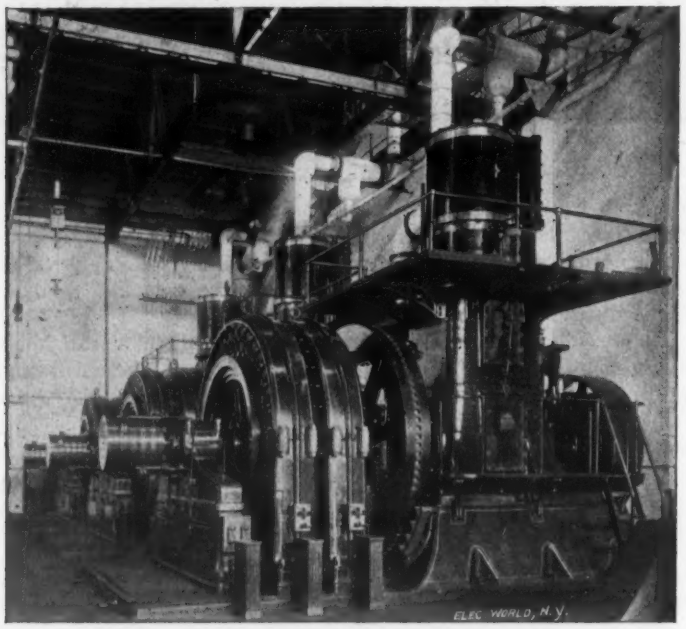
The normal steam pressure carried is 160 pounds, the safety valves being muffled to avoid noise and inconvenience to the residents of the district nearby when the valves blow off.

The three large engines are direct coupled to three Westinghouse alternating dynamos, also of the World's Fair type. These dynamos, as originally built, were belted machines wound for 2100 volts. and provided with commutated coils for field compensation. They are now, however, rewound for 2750 volts, with no compounding system, and are direct coupled to the engines. Each machine consists of a double ring of field magnets and two separate armatures, which may be displaced from each other by a sufficient amount to give two-phase current, this arrangement allowing the independent regulation of the voltage on the two phases. The fields are supplied at 220 volts, the current necessary for excitation being about 36 amperes. The two sides of the machines are used separately on lighting loads, no use being made at present of the two-phase relation, although this could be done at a moment's notice. The three generators are run independently, although they have been multipled experimentally with satisfactory results. The collector rings overhang the outboard bearings, as may be seen in the accompanying illustration, the leads being brought out through the hollow shaft. The currents are conducted from the machines to the switchboard by Standard underground lead-covered cables.

The main switchboard is of white marble, over 20 feet high, the upper part being reached by a gallery. The part below the gallery is devoted entirely to the dynamo circuits, the upper part being the feeder board. The right hand end of the dynamo board, which contains in all twenty panels, is devoted to the direct-current service, both dynamos and feeders being controlled thereon. The switchboard for the large alternators consists of five double panels, two of which are at present in reserve. Each half of the double panels is equipped with instruments and regulating devices arranged to independently indicate and regulate the two phases of the machine. No fuse blocks are used in these panels, the machine fuses being placed on the alternators. The exciting circuits are closed and opened by plug switches, in order to blow out as quickly as possible the arcs maintained by the self-induction of the fields.

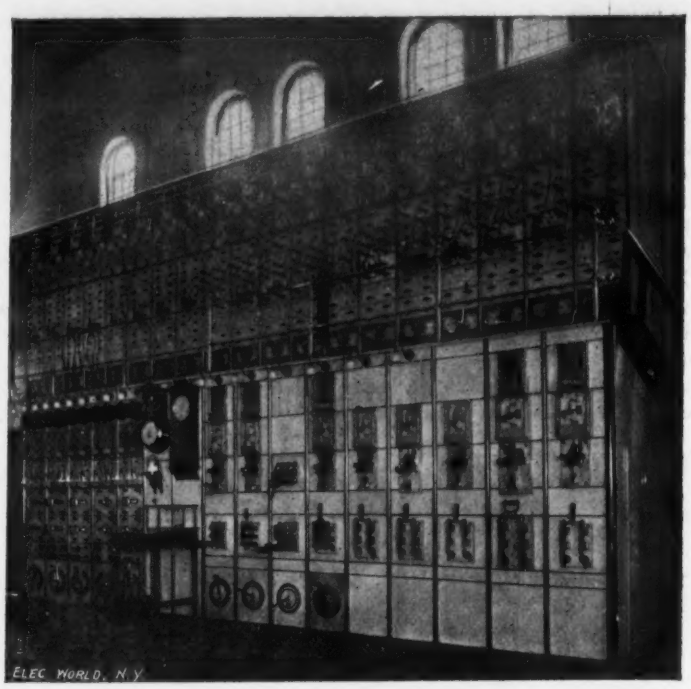
Four complete sets of bus bars (four bars to the set) run behind the feeder board for its whole length and are tapped off to receptacles on each panel, the main switches in the dynamo panels on the floor below merely serving to connect or disconnect the machines from their own sets of bus bars. The feeder panels above the gallery are equipped with Wurts non-arcing lightning arresters, switchboard transformers, compensators, pilot lamps, voltmeters, ammeters, feeder plugs, Stillwell regulators and double-pole throw-over switches, to the centre points of which the feeders are connected, the outside points connecting with receptacles which can be plugged to receptacles connected to any one of the sets of bus bars. In normal running these switches are, of course, closed on live bus bars, the throw-over points being connected to a set of bus bars on one machine ready for emergency work. In case any machine gives out this reserve machine can be promptly started, and the feeders thrown over onto it with but a brief wink of the lights. All the panels are symmetrically wired and numbered throughout the whole board, so that a glance at the arrangement of the plugs on the board indicates the exact arrangement of the circuits. The plugs and holes are made of different shapes for the two sides of the circuit, so that it is impossible to plug one cord to the two sides of the machine, thereby short circuiting it.

The normal voltage of the system is 2750, the transformers being wound for a ratio of 1 to 25, thereby giving 110 volts on the lamps. The feeder voltmeters are all equipped with compensating coils, the feeders passing through small series transformers, the secondaries of which are connected to coils in the instruments which tend as the load rises to reduce the magnetization of the shunt coils. To provide for feeders of various lengths the compensating current is carried through a multi-point switch by which the effect can be rendered greater or less according to the resistance of the line. The feeders are properly compounded by means of Stillwell regulators, the series coils of which are brought out to switches by which the boosting can be manually adjusted. These instruments give regulation up to 10 per cent., a switch being provided for reversing the current in the primary of the regulators so that they may be used to lower as well as raise the voltage. Each feeder panel is also provided with double-pole fuses of aluminum foil mounted in lignum-vitæ boxes fitted with large brass terminal plugs by which they may be introduced into the spring jack terminals of the circuit, allowing them to be readily withdrawn for re-fusing.



Two-Phase Direct-Coupled Alternators.

The direct current board is fitted with the usual instruments, including automatic circuit breakers, all the wiring being done on the back of the board. The direct-current machines are one 250-kw 250-volt belted generator and two direct-coupled 75-kw 250-volt generators, the latter being generally used as exciters. These machines are all driven by Westinghouse engines, the belted engine also driving three 80-light Brush arc machines with tandem belts on one pulley. These arc machines are of the latest type with revolving magnetic clutch regulators. In addition to these dynamos there are eighteen old-style Brush arc machines and five Westinghouse arc machines. The Brush machines are of 60-light capacity each, and are belted in groups of six to three Westinghouse engines of 350 horse-power each, the belts being laid up tandem three on a pulley. The 75-light Westinghouse arc machines are separately excited from the bus bars of the 220-volt system. They are also tandem belted to a 350-hp Westinghouse engine, two on one side and three on the other. All wires from these machines pass through a subway to the arc switchboard. This is made of polished brown marble with brass trimmings, and a sufficient number of plugs to accommodate twenty-six machines and as many circuits. The receptacles are of an improved type, making four surface contacts on a plug. All the feeders from the switchboard go to the cellar subway and pass under the sidewalk in front of the station, rising on two large poles and spreading out to the distribution circuits.



Main Switchboard.

Municipal Electric Light and Power in Germany.

In the following cities in the German empire the municipal authorities own and manage the electric works that supply light and power: Bremen, Barmen, Cassel, Darmstadt, Düsseldorf, Elberfeld, Hanover, Cologne, Königsberg, Lubeck, and Pforzheim. All of these cities, with the exception of Hanover, also own the gas works. The following cities have constructed the electric works for the purposes of light and power, but have leased the management of the same to private operators: Aix-la-Chapelle, Chemnitz, Frankfort, Strasbourg and Stuttgart, all of which, with the exception of Chemnitz, are cities where the gas works are under the management of private corporations. In the following cities, private companies have established electric works with the agreement that, under certain conditions, the municipal authorities shall have the privilege of securing absolute control and ownership by purchase: Altoona, Dessau, Gera, Hagen, Heilbronn, Leipsic, Mülhausen, Stettin, and Zwickau. Of these cities, the gas works are under private control in Dessau, Hagen, Mülhausen and Zwickau.

Use of Electric Motors in Paper Making.*

BY DR. LOUIS BELL.

Every special industry presents to the electrical engineer a series of problems peculiar to itself. We have fortunately passed out of the period during which electric motors were regarded as the craftsmen of an omnipotent mystery. The only halo now surrounding them is occasionally noted about the commutator with remarks far from suggesting reverence. To-day electric power must stand upon its own merits and be accepted or rejected as it is or is not well fitted for the purpose in hand.

Speaking broadly, the fewer intermediaries between the point at which power is generated and that at which it is utilized, the better for economy so far as power is concerned. And, therefore, if an electric motor is thrust between the prime mover and its work it must show good cause for its presence. The energy necessarily lost in it must be compensated by a greater saving of energy somewhere else, or by some economy in time or labor sufficient to be worth the while.

Whenever electric motors have proved important adjuncts in any manufacturing process it has usually been for one or more of the three following reasons, each of them definite and sufficient: First, they may have enabled a cheap prime mover to be substituted for a costly one. Second, they may have materially reduced the energy lost between the prime mover and the point at which its power must be applied. Third, through their characteristic facility of application they may have been able to replace manual labor at some point in the process of manufacture. Beyond this electricity may have an intrinsic value as the source of new processes, but electric power, as such, takes in these no part.

Numerous paper mills have to face the dilemma of paying heavy freight bills on their raw material or producing their power by steam where the cost of coal is high. Inasmuch as steam is needed in the process of manufacture it is quite usual to drive part of the plant, particularly the Fourdrinier machines, by engines, using the exhaust steam for heating purposes.

Now, at the risk of being accused of "teaching my grandmother to suck eggs," I am going to enter a vigorous protest against this practice. It is most emphatically not true that steam thus obtained is cheaply obtained. It implies in the first place very uneconomical use of the engines, and, in the second place, it virtually amounts to generating steam for heating at a high pressure and reducing this to 8 or 10 pounds by the use of a very expensive reducing valve. It is well within bounds to say that the fuel bill for the power is doubled by thus working the engines non-condensing with considerable back pressure, and the cost of the steam used for the heating is thus really a most unpleasant item. For example, take a plant requiring 10,000-hp hours per day, and 50,000 pounds of steam for heating purposes. If worked in the common way there will be required for power not less than 300,000 pounds of steam, demanding burning, say 20 tons of coal under the boilers. Working condensing the same power can be obtained for about 180,000 pounds of steam, say for 12 tons of coal, while the extra 50,000 pounds of steam for heating call for about 3 tons more, making a total of 15 tons daily. A demand for heating capacity so great as to render the power generation a mere accessory would only show very bad utilization of the heat.

In my opinion the first and greatest use of electrical apparatus in paper making is in supplying cheap motive power from waterfalls, enabling the mills to be located at points favorably situated with respect to cheap raw material and easy shipment of product. These advantages once gained the power can be delivered from the nearest available waterfall at a cost generally lower than the local cost of steam power.

It must be distinctly remembered that power thus transmitted electrically is not at all necessarily cheaper than steam power, but in a very large number of cases it is. From the investigation of probably several hundred propositions of this kind, I feel well within the bounds of truth in saying that with coal at about $3.00 per ton the electrical transmission of 500 horse-power or more from an average water-power anywhere within a radius of 15 miles will pay nine times out of ten. This is the case with power transmitted for ordinary purposes, and when, as in paper making, power is often used continuously throughout the twenty-four hours, the conditions become even more favorable for electric working.

At the present time there are above a hundred electrical power transmission plants operated from water powers in this country alone. A number of them have been working for five years or more, and I have yet to learn of a single case in which these plants have been unable to compete with steam power on satisfactory terms, save in the case of some very large steam plants. Transmission has uniformly proved successful, both in the matter of cost and in reliability, which in many industries is quite as important. And in paper-making regions water powers can generally be more cheaply secured and developed than when they are located near a city which furnishes in itself a good market for power. I am glad to say that in a few instances transmitted power is actually in use in paper mills and all the reports received seem to indicate the success that was to be anticipated. There is nothing experimental in electrical power transmission under ordinary circumstances. The apparatus as now constructed is as manageable and reliable as steam apparatus and may be installed with the same assurance of success. Until within the past three or four years one would have hesitated to advise driving from water power, either directly or indirectly, any machinery requiring uniform speed at varying load. Now, however, water wheel governors are regularly in use which are able to hold the speed with an exactness quite comparable with the governing of a good engine. There are few places where uniformity of speed is more highly valued than in a cotton mill, and there are now a half dozen large mills relying entirely on electrically transmitted power—and using it because it is actually cheaper than steam power, although some of the very best steam practice is to be found in the cotton industry.

I can in no way better emphasize the dollar and cent side of the problem than by making an estimate for a typical case of the kind. Let us assume that one of you has a mill which requires, say, 1000 horse-power delivered continuously for all purposes. Near the proposed site of the mill there is merely a stream big enough to supply water for general purposes, but 10 miles away is a good water power which can be secured without unreasonable expense. What will be the cost of the power-transmission plant necessary to do the work?

To begin at the power house, we must allow, say, 1000 kilowatts in capacity, with preferably a generator in reserve, say three 500-kw direct-connected machines, if the speed of the wheels will allow. The market price of such machines, complete with station equipments, and wound for 5000 or 6000 volts, including installation, will not exceed $10,000 each. It is almost unnecessary to state that for a transmission of this length one of the polyphase systems would always be installed. The present tendency is toward high-voltage generators, connected directly to the line for such cases, although low-voltage generators with raising transformers can be obtained for not far from the same price. In any event, reducing transformers for 1000 horse-power would have to be installed at the mill, in large units of which the aggregate cost would not exceed $5000 to $6000. The 1000 horse power in motors would be needed for driving the various parts of the mill, and assuming units of 100 horse-power or more the probable cost of these motors would be $15,000 to $20,000, depending somewhat on the size and speed of the various units. This completes the necessary electrical machinery. The line, assuming say 6000 volts delivered and 10 or 12 per cent. drop, could be erected with all copper up for less than $20,000. Altogether, the machines at both ends of the line and the line itself could be installed, including a suitable station, for about $80,000; under favorable conditions for somewhat less.

The cost of the water privilege and the necessary hydraulic work is the most uncertain factor in working out any assumed case of power transmission. It may fall even to $25 or $30 per horse-power, and it may rise to $150 or $200. Taking the general average of powers in regions where they have not yet acquired an artificial value by proximity to towns, one may say without being widely astray that $75 per horse-power will cover the necessary expense. With a considerable head this figure will be somewhat reduced.

For a rough estimate of the hydraulic cost in the case in hand, we shall be fairly near the mark in doubling the cost of the electrical part of the equipment, making $160,000 as the total investment in the power plant for furnishing 1000 horse-power day and night. A brief expense estimate will show how important a saving can be effected by this utilization of electric power.

This figure of $160,000 is certainly conservative enough, since I have in mind one plant with a generating station of 1000 horse-power which was installed complete, including distribution lines to the amount of $15,000, but no motors, for less than $125,000, and this at a time when electrical machinery was considerably more costly than at present.

*Extract from a paper read before the New York meeting of the American Paper and Pulp Association February 17, 1898.

Now, as to operating expense the figures are not difficult to secure. In the first place we will allow for interest on the investment at 6 per cent., and will charge annually 4 per cent. to the credit of a sinking fund, for depreciation or replacement. Then we will add 2 per cent. for insurance and taxes—certainly an ample allowance. The total annual charge due to these items then becomes $21,600. We can then make up the regular operating charges about as follows: Labor, eight men and team, $6500; supplies and general maintenance, $5000. These figures are more than ample for any ordinary case. Summing them we arrive at $33,100 as the total annual cost of 1000 horse-power for twenty-four hours per day, which brings the charge per horse-power year down to $33.10. This power generated by steam, with coal at say $3 per ton, using the non-condensing engines too often employed, would cost at least double the amount mentioned, and even with a first-class steam plant the cost would fall little, if any, below $50 per year. In other words, the net yearly saving by employing electrical transmission in such a case as we have assumed amounts to from $15,000 to $30,000 per year. And this figure could often be exceeded under the conditions actually existing in paper-mill work.

The question of electric heat for the drying rolls, and generally for freeing the pulp from water, has been several times broached to me recently. It is only fair to say right now to those interested that the amount of power required to furnish heat for drying the daily product of a modern paper mill is enough to stagger the wildest-eyed and longest-haired electrical crank who ever claimed that electricity was in its infancy. That drying by steam is expensive is painfully evident to anyone in the business, but if you are minded to seek for improvements do not take up electrical heating until you have exhausted the possibilities of producer gas.

To sum up, the best field for the use of electric motors in paper manufacture is in reducing the cost of power, by utilizing the now well-tried methods of power transmission. By this means a mill can be located so as to obtain its material and ship its product economically, without foregoing the advantages of cheap water power. With the transmitted energy at hand, power can be economized by the skillful use of motors in its distribution. There is no cut and dried rule or formula by which the best equipment can be at once determined. Each case has to be considered on its merits, and by the light of common sense, for in the last resort the best equipment is the one which enables you to turn out a given grade of paper at the lowest price.

An Exaggerated Objection to the Rotary Converter Sub-stations.

In the discussions of the use of rotary converter sub-stations and alternating supply for heavy railroad work, the objection is invariably made that the maintenance of these sub-stations would incur a large and unjustified expense in the wages of attendants. In practice it will probably be discovered that this becomes a comparatively insignificant item. Every railroad traversing a well-populated district maintains at each village, town or city a station requiring the services of two or more persons. These are also located, occasionally, between stations, at telegraph offices made necessary by junctions, tunnels, etc. Of course, each railroad and each division of a railroad has its peculiarities in this regard, but it will be found that in many instances rotary converter sub-stations could be so located that employees whose time is not fully taken up, but whose presence is necessary for other purposes, would become available as attendants. It would not be a difficult matter for the station agent or telegraph operator to become competent to attend to the sub-stations, which could be so located as to be given the necessary attention without conflicting with his other duties.

Another considerable advantage to be gained by the sub-stations, and one which will be appreciated, is the facility afforded the railroad for securing lighting for its passenger and freight stations. This item alone might be found to compensate to a considerable extent for the added expense of an occasional extra attendant.

Of course each railroad has its peculiarities in regard to the location of station men along its line, but engineers in making estimates ought to examine these conditions carefully before including too much expense for sub-station labor. In practice the item will be found to be very small.

Aluminum as a Rival of Copper for Electrical Conductors.

BY ALFRED E. HUNT.

Copper has been used for electrical conductors very largely in the past, due to its comparatively high electrical conductivity, power of withstanding corrosion, ease of soldering and brazing, malleability, tensile strength and ductility.

Copper has a specific gravity of 8.93; an electrical conductivity, when pure and annealed reckoned at 100 in the Matthiessen Scale, but as ordinarily used in electrical conductors of about 98, a tensile strength of from 16,500 pounds per square inch in soft annealed pure copper to 65,000 pounds per square inch in hard-drawn bars; and a selling price of about 14 cents per pound in the United States for wire, bars, and rods such as are used for electrical conductors.

Aluminum has a specific gravity of 2.68; an electrical conductivity (commercially pure metal) of 63.00; a tensile strength in pure soft wire of 26,000 pounds per square inch, and in hard-drawn rods or wire, of 40,000 pounds per square inch.

From these facts it is evident that:

Any given volume of copper is 8.93/2.68 or 3.33 times heavier than an equal volume of aluminum.

To obtain a wire or rod of equivalent resistance per unit length, the cross-section of the aluminum should be to the cross-section of the copper as the conductivity of the copper per unit volume is to the conductivity of the aluminum, or as 100 to 63. This necessitates the use of aluminum conductors of about 1.6 times as great cross-section as the copper conductors they are intended to displace. On account of the fact that the specific gravity of the copper is 3.332 times as great as that of the aluminum, the weight of the aluminum conductor, with a cross-section 1.6 times that of the copper, will be only 1.6/3.332, or about 48 per cent. of the weight of the copper conductor of the same conductivity.

To obtain, therefore, a conductor of aluminum at the same cost of metal per ohm per mile, the cost per pound of the aluminum may be about 2.1 times that of the copper; assuming the cost of copper at 14 cents per pound, it is evident that aluminum at 29 cents per pound is slightly cheaper than copper.

In the feature of tensile strength, American requirements call for about 32,000 pounds per square inch for annealed copper wire. Aluminum wire, rods or bars can be furnished of 63 per cent. electrical conductivity, with an equal tensile strength per unit of area with the copper. Therefore, with the equivalent conductor mentioned above, the total tensile strength will be 60 per cent. greater than that of the copper, while the total weight and strain, due to weight, will be but 48 per cent of that of the copper conductor.

Properly drawn aluminum wire is as tough, and will stand bending as severely, without breaking, as soft copper wire. The aluminum wire could, therefore, be used on longer spans without supports than could the other. If drawn too severely, however, or not well annealed at proper intervals in the drawing operation, it comes out much more brittle than when properly manipulated.

Hard-drawn copper wire, especially that in the smaller sections drawn through diamond dies, is furnished with a tensile strength of 65,000 pounds per square inch. What the maximum tensile strength of the best pure hard-drawn aluminum will reach under similar favorable conditions for developing the maximum tensile results has not yet been determined, but from experiments already made it can quite surely be predicted that at least 50,000 pounds per square inch can be obtained, and perhaps even higher strength still.

Aluminum hardened with a few per cent. of alloying ingredients can be furnished in wire with a tensile strength far in excess of what can be obtained in pure aluminum. Experiments are now being made by the Pittsburg Reduction Company to determine just what alloy will furnish the maximum tensile strength, together with maximum electrical conductivity. From results already obtained it can surely be predicted that an alloy of aluminum can be furnished which, drawn into wire, will have a tensile strength of at least 65,000 pounds per square inch and electrical conductivity of more than 50 in the Matthiessen Scale. This material will rival hard-drawn copper wire and the silicon-bronze materials which are now in use, where maximum tensile strength, together with good electrical conductivity, is required.

The power of withstanding corrosion is greatly in favor of aluminum as an electrical conductor over copper. Copper does not change in dry air, but in moist air it becomes covered with a green layer of basic carbonate of copper, which itself has a corroding

action and does not coat and protect the underlying copper from further corrosion. Ammonia in contact with copper absorbs oxygen and the copper dissolves in consequence of the formation of a soluble cupric oxide and ammonia. This action is especially a source of trouble where copper wire is used in connecting rail joints in the tracks of electrical railroads where the ground is often subjected to ammoniacal solutions.

Aluminum similarly is not acted upon in dry air and the corrosion in moist air is of the oxide of aluminum, alumina, a harmless salt which forms an impenetrable coating on the metal and protects it from further corrosion to a considerable extent. Ammonia solutions act on aluminum only upon the surface, attacking it and leaving behind a more resisting surface coating of a brown color containing silicon, which resists corrosion from dilute mineral acids and dilute solutions of organic acids as well as moist and dry air. Subject to sulphur gases, such as locomotive flue gases, aluminum withstands corrosion better than copper.

If kept free from galvanic action with any other metals electro-negative to itself, aluminum is far less easily corroded than copper.

The difficulty of soldering or brazing aluminum is the chief drawback to its use as an electrical conductor. Aluminum can be soldered strongly, but it is a more difficult and slow operation, at best, as compared with copper, and there is much more rapid weakening of the soldered joint, due to galvanic action between aluminum and the metals of the solder, than with the less electro-positive metal, copper.

In many places the aluminum can be first coated with copper, and the soldering or brazing operation made on the copper surfaces thus formed.

Several forms of joints have been successfully used to avoid the necessity of soldering, the best forms being those using thin aluminum sheets to wrap the joints and to twist or otherwise bind with the aluminum bars or wires to be joined. These wrapped and twisted joints with aluminum sheets can be left smooth on the outside when desired, can be made much stronger than the body of the conductors, and make often a more serviceable joint than soldered or brazed work copper. One very practical way of making joints of aluminum wire is to roll the thin aluminum sheet of about 6 inches width into two cylinders from opposite edges of the sheet. These double cylinders are very cheaply made on mandrels in a lathe. The ends of the wires to be joined are inserted in these cylinders from opposite ends and both the wire and sheet twisted with pliers until a firm joint is secured, much stronger than the body of the wire. The joint can readily be made impervious to air and moisture.

The C. McIntire Company, of Newark, N. J., has such a patented joint, as has also the American Fuse Company, of Chicago.

Another disadvantage which handicaps aluminum in special uses for electrical conductors is that the cost of insulation will be greater for the larger section required in aluminum over that of copper.

There are also certain places where aluminum will be at a disadvantage over the smaller section of equal conductivity of copper, such as ducts or conduits, where space is a considerable item. In such cases, the use of aluminum would probably be prohibitive.

An ample field for the employment of aluminum for some time to come, however, seems open at the present time for bare transmission lines, especially for high-potential long-distance work, and for long-distance telephone lines and for rapid transmission telegraph lines.

Next to gold, aluminum is the most malleable of all the metals, being much more malleable than copper. In ductility it stands next to copper and is easily drawn into all sections that are furnished in copper for electrical conductors. It can also be furnished fully as uniform in composition as copper.

The metallurgy of copper is comparatively complicated, owing to the difficulty of converting its ores into the oxide free from impurities. In most of the copper ores used, sulphur, lead, and iron are contained, as well as small quantities of other elements, as arsenic and antimony. All of these elements in metallic copper very materially lower its electrical conductivity. The native pure copper of the Lake Superior region enjoys the preference, due to its uniformity and freedom from impurities for many purposes, but for electrical conductors the electrolytic copper is most used.

Aluminum can now be furnished rivaling in purity of composition the best electrolytic copper used for the purpose of electrical conductors. When as pure a metal is obtainable, undoubtedly it will more nearly rival copper in electrical conductivity, section for section.

Aluminum has been already in successful operation as an electrical conductor for some time. The first use in a large way was with the conductors for the electric current at the Niagara Falls works of the Pittsburg Reduction Company, where it has been used since the year 1895. Several thousand horse-power is transmitted by a large current at a comparatively low voltage. Both in conducting power, freedom from heating, power of withstanding corrosion, ease of making, wear, and efficiency of joints, the aluminum conductors have given better results than copper used for the same purpose.

In the Chicago stock yards a mile of aluminum wire of No. 11 gauge has now been in use for some time upon a telephone line where copper wire was badly corroded, due to its being frequently subjected to sulphur gases from passing locomotives. The aluminum line is giving good satisfaction and is withstanding corrosion much better than did the original copper wire subjected to the same influence.

If the theory be true that the passage of high-voltage alternating currents of great frequency is largely upon or near the surface of the conductors only or mainly, then the larger section of the proposed aluminum conductors will make them especially adaptable for such currents.

On telephone lines it has already been determined that as good sound transmission is obtained with aluminum of equal section as with copper, in ordinary lengths of less than 10 miles of wire. No comparative results, however, have as yet been determined on long-distance telephone transmission; but the evidence would seem to indicate that a much smaller section than 160 of aluminum to 100 of copper will give equally good results.

Where a low electrical conductivity is desirable, as in parts that are moved in a magnetic field to prevent the occurrence of eddy currents, aluminum can be alloyed with zinc and other metals that will lower its electrical conductivity to the desired point.

Contemporaneous Legislation Affecting the Electrical Industries.

A few of the measures now under consideration by the governments of the different States of the Union for the regulation of the electrical industries are given below.

In New York State a bill has been introduced to regulate telephone charges. It limits the rate for the use of telephone communication by day or night in cities of 1,000,000 inhabitants or over to a maximum of $85 per annum; between 500,000 and 1,000,000 to $75; between 100,000 and 500,000 to $48; 20,000 and 100,000, $36; between 8,000 and 20,000 to $30, and in all places of less than 8,000, $27. The charge at the public pay stations in any place shall not exceed 10 cents for the first five minutes and 5 cents for each five minutes thereafter. No person having or paying for a telephone at his own home or office shall be charged for the use of a telephone at a public pay station, when used by him or his employees for communicating with his own home or office, and all subscribers shall be furnished with certificates entitling them to such free use of pay stations.

It is expected also that a bill will be introduced by the request of the Theatre Alliance and Electrical Workers providing for the appointment of a State inspector to inspect play houses to see that they are in a condition to properly protect the lives of patrons and employees.

In the State Legislature of Virginia there has been introduced a bill to prevent the unlawful use of telephone lines and instruments and to protect them from injury. Another Virginia bill provides for the protection of electric lighting and power companies from the theft of electric current or unlawful interference therewith. The measure also provides a penalty for the intentional prevention of an electric meter from properly registering, or the diversion of an electric current from the wires of any company.

In Iowa a bill has been introduced modifying the taxation of telegraph, telephone and other quasi-public corporations, by distributing the value of the property uniformly over the entire mileage, every mile being valued the same, so that a mile in Iowa would be taxed the same as a mile in the heart of Chicago or New York City.

In Ohio there is now under consideration a bill providing that wires of all telegraph, telephone, electric light or other companies, running adjacent to the line of steam railroads, shall be placed on substantial poles set in the earth not less than 4½ feet, the poles to have double cross arms and glass insulators.

In Illinois a bill has been introduced providing for the taxation of telephones at the rate of $10 per instrument per year.

A Method for the Accurate Measurement of Low Resistance.

BY WILBUR M. STINE.

One of the most important classes of measurements in the electrical laboratory is that involving the calibration of current, pressure and power meters. By the use of the potentiometer scheme and a standard cell, the voltmeter may be calibrated with a high degree of accuracy; but the calibration of the ammeter has been a more uncertain procedure, and the accuracy of the result is usually doubtful. The silver and copper voltametric methods, and that of the tangent galvanometer, are rarely used since it has become possible to obtain fairly reliable standards of low resistance capable of carrying large currents. The potential differences over such resistances are determinable with high accuracy, and if the resistance of the standard can be verified this method for the calibration of the ammeter leaves little to be desired. But this verification of standards of low resistance is a matter usually attended with such difficulties and probable sources of error that it is not generally attempted.

There is perhaps no better means known for the comparison of low resistances than the Carey Foster method with a suitable commutator, and the method to be described is a modification of this class of measurements. The essential idea in this modification is the employment of the standard of low resistance as the bridge wire.

THE CAREY FOSTER METHOD.

For the sake of continuity in this discussion the principles governing the Carey Foster method will be briefly stated. The scheme of the circuits is outlined in Fig. 1. The symbols employed in this discussion are:

P, a standard ohm.
Q, a balancing ohm.
R_1 R_2, approximately equal resistances.
$r_1 \ldots r_6$, resistances of the connections.
L, the length of the slide wire.
x_1 x_2, readings of the balance on the slide wire.
ρ, the resistance of unit length of the slide wire.
The convention here adopted is that the slide wire shall be read

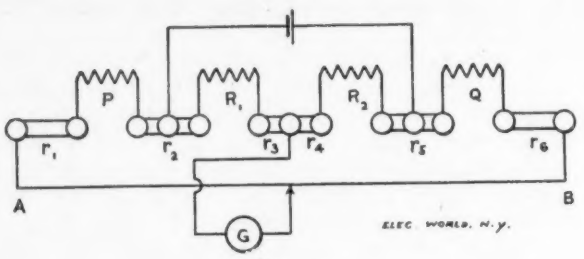


Fig. 1.

from the left-hand end. The balancing coils, R_1 R_2, used in this determination, should preferably be about one ohm each.

When a balance is indicated by the galvanometer, there are the relations:

$$\frac{R_1+r_2+r_3}{R_2+r_4+r_5}=\frac{P+r_1+x_1\rho}{Q+r_6+(L-x_1)\rho} \quad \ldots\ldots(1)$$

The positions of P and Q are then reversed by the commutator and a new balance obtained. Then,

$$\frac{R_1+r_2+r_3}{R_2+r_4+r_5}=\frac{Q+r_1+x_2\rho}{P+r_6+(L-x_2)\rho} \quad \ldots\ldots(2)$$

By composition, equation (1) becomes

$$\frac{R_1+r_2+r_3}{R_1+R_2+r_2+r_3+r_4+r_5}=\frac{P+r_1+x_1\rho}{P+Q+r_1+r_6+L\rho} \quad \ldots(3)$$

Similarly for equation (2),

$$\frac{R_1+r_2+r_3}{R_1+R_2+r_2+r_3+r_4+r_5}=\frac{Q+r_1+x_2\rho}{P+Q+r_1+r_6+L\rho} \quad \ldots(4)$$

Since in equations (3) and (4) the first, second and fourth terms are identical, the third may be equated. The equation reduced is

$$Q-P=(x_1-x_2)\rho \quad \ldots\ldots(5)$$

which is the working formula for this method.

The particular form of commutator shown in the sketches (see (Figs. 2 and 2*a*) is one the author devised in 1893.* Its advantages are freedom from short circuits and certainty of operation by being direct reading.

PRELIMINARY ADJUSTMENT.

A verified standard ohm, P, is placed on the left, while Q is another resistance, preferably a standard ohm whose value is a little greater than P. These resistances should be immersed in kerosene to avoid temperature changes.

A preliminary adjustment is essential in order to balance the sides of the system of resistances. The diagram of the circuits is shown in Fig. 3, where an ordinary slide wire bridge, A B, is connected to the commutator. The resistance Q must be brought to the exact re-

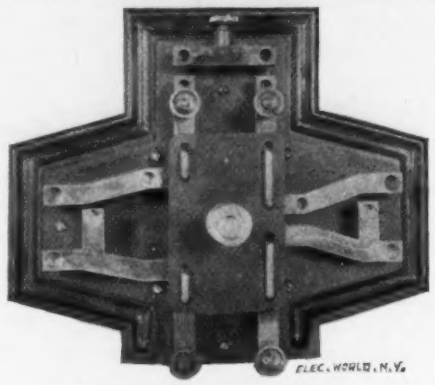


Fig. 2.

sistance of the standard ohm, P. If Q is in excess it is shunted by a variable high resistance, until on reversal of the commutator the zero on the galvanometer is not disturbed. This condition is necessary in order to indicate that the heavy connectors and the mercury contacts of the commutator balance each other. If Q is less than P, they may be brought together by using a short piece of wire in series with Q.

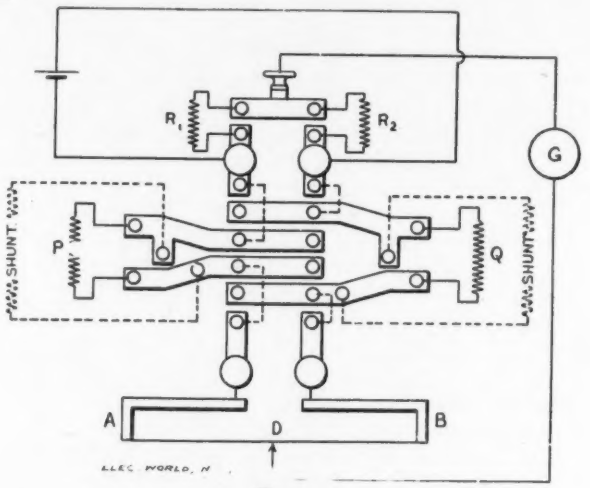


Fig. 3.

When reversal is without influence on the galvanometer with the contact fixed at D, $x_1 = x_2$, and from equation (5), $Q - P = 0$.

DETERMINATION OF THE LOW RESISTANCE.

The particular standard of low resistance referred to in Fig. 4 as

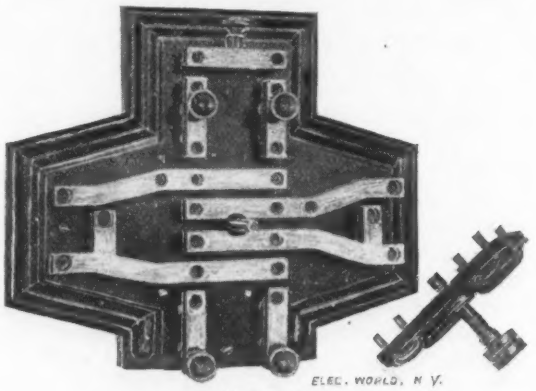


Fig. 2A.

S L R is of the well-known Reichsanstalt pattern and was marked .001 ohm.

The slide wire bridge is disconnected from the commutator and the terminals of the low resistance are connected in its stead with suitable conductors. It is desirable to have one connection made through a

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pair of mercury cups, as shown at *C* in the sketch. The pair of cups is spanned by a wire whose length may be readily adjusted.

The standards of low resistance are provided with a massive shunt bar. This is put in place and one galvanometer terminal attached to the post *b* of the low resistance. It is evident that the low resistance will serve as a bridge wire when the shunt bar is removed. The balance point must be brought on the post *b*, and this is accomplished by altering the length of the wire spanning the mercury cups until the deflection is zero. To further test the equilibrium of the sides of the system the commutator may be reversed when the zero deflection of the galvanometer should not be disturbed.

The shunt bar is now removed. This is equivalent to a slide wire lengthened on the left-hand side by an amount equivalent to the resistance of the standard to be tested. In order to restore the balance the standard ohm *P* is shunted by a resistance box until the balance is again restored. This is an inversion of the usual procedure with the well-known comparison method.

The resistance may now be calculated, but it is well to verify it by another transposition. To do this the commutator is reversed, throwing the standard *P* to the right, the galvanometer terminal being at the same time removed to the post *a* of the low resistance. If the proper balance has been obtained and the mercury cups and the connectors of the commutator are in balance, this reversal should not disturb the zero deflection of the galvanometer.

Since the resistance of the standard ohm, *P*, has been lessened by the exact amount of the low resistance introduced into the circuit,

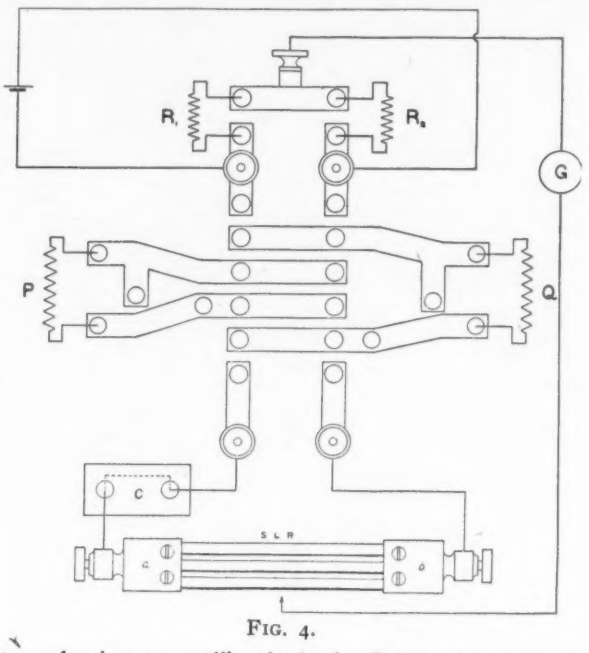


FIG. 4.

this latter value is now readily obtained. Calling the shunted value of *P*, *P'* and *R* the resistance sought,

$$R = P - P' \quad \ldots\ldots(6)$$

If *s* is the resistance in shunt to *P*,

$$P' = \frac{s \times P}{s + P} \quad \ldots\ldots(7)$$

The accuracy of this method is limited by the thermal disturbances and the sensibility of the galvanometer.

In the test of the low resistance standard marked .001 ohm, *P* may be assumed to have been exactly one ohm. On test the resistance in shunt to *P* was found to be 900 ohms. Then *P'* would have the value,

$$P' = \frac{900 \times 1}{900 + 1} = 0.99889 \text{ ohms} \quad \ldots\ldots(8)$$

and

$$R' = P - P' = 0.00111 \text{ ohm} \quad \ldots(9)$$

But in the test the galvanometer was found to be sensitive only to a change of 2 ohms resistance in *s*. Repeating the calculations for the lower limit of *s*, 898 ohms,

$$R'' = 0.00112 \text{ ohm} \quad \ldots\ldots(10)$$

and

$$R'' - R' = 0.000{,}01 \text{ ohm} \quad \ldots\ldots(11)$$

The sensibility here shown is about 0.9 per cent.

With a higher sensibility of the galvanometer a change of one ohm in *s* was noticeable. Repeating the above calculations for the new limit of 899 ohms,

$$R''' - R' = 0.000{,}0013 \text{ ohm} \quad \ldots(12)$$

The result is that the sensibility of the determination is now nearly 0.11 per cent.

A general expression for the sensibility may be worked out by using the above algebraic terms instead of numerical quantities in the final expression.

A test of such delicacy demands that due precautions be observed. The galvanometer selected should be one of very low resistance, such a one as would be employed for the comparison of standard ohms. It is advisable to make all the connections as heavy as possible, so that the small changes of resistance in the essential elements of the circuit will result in relatively large changes in the potential differences over them.

The greatest difficulty occurs in the reduction of the thermal E. M. Fs. of the contacts. But these may be made sufficiently small by placing all the apparatus, except, perhaps, the shunt resistance box to *P*, under a suitable cover. The cover may be hinged in front to facilitate the reversals of the commutator and the galvanometer connections.

This method was devised by the writer in 1895 and since then has been in frequent use in the laboratory. It has many points of similarity to apparatus and methods used for determining the conductivity of heavy conductors. One of the most interesting of the latter class is a direct reading conductivity bridge designed by Mr. Elmer Willyoung and described at length in THE ELECTRICAL WORLD, November 13, 1897, page 579.

The Starting of Alternating Current Motors.

A novel attempt at the solution of the important problem of starting multiphase motors with short circuited secondaries under load has been described by Mr. Paul Boucherot in a paper read before the Société Internationale des Electriciens. For efficient running such motors are necessarily provided with low resistance secondaries, the torque with such secondaries being quite low at low speeds, owing to the demagnetizing action of the excessive currents in the short circuited windings. The ordinary method of avoiding this is the provision of a resistance which may be inserted in the secondary at low speeds and cut out when the speed approaches synchronism, but this necessitates either collector rings and brushes or switching devices in the rotor, operated by a more or less complicated controlling mechanism. If the short circuited winding is made of a comparatively high resistance, the torque increases as the speed diminishes, thus making the motor capable of starting with a torque even in excess of its rated load, but this, of course, spoils the speed regulation and reduces the efficiency by increasing the slip. Mr. Boucherot proposes the use of two short circuited windings, one of low resistance and one of high resistance. The two are wound in deep slots or concentric rings of tunnels, the high resistance winding being nearer the air gap. The designer's idea in this is to superpose the torque curve of the high and low resistance windings, thereby obtaining a more nearly uniform torque at various speeds. By this construction the mutual induction of the primary and low resistance secondary would be diminished, thereby diminishing the demagnetizing effect at low speeds, the field acting at these speeds more on the high resistance winding nearer the air gap surface, while at speeds near synchronism the self-induction of the low resistance winding would be of comparatively small effect, owing to the greatly reduced frequency of the alternations acting upon it.

Comparisons of English and American Practices.

In an address recently delivered by Prof. W. E. Ayrton at the Coventry Technical Institute several remarks were made in the nature of comparisons between English and American customs. Attention was called to the fact that in the United States, where machinery is most used, workingmen's wages are higher. "The American people," said the lecturer, "have been reserving men for the brain work of labor." America has in that way been enabled to set up rivalry with Great Britain and to compete with the latter on her own ground. Englishmen must show themselves ready to adapt themselves to new methods of manufacture or the rivalry will greatly increase. It is the duty of manufacturers to create wants as well as merely to supply existing demands. American manufacturers believe in the proverb "The appetite grows by what it feeds upon." On the contrary, the British manufacturers, with few exceptions, are unwilling to supply a novelty until it ceases to be one.

Electricity in Paper Making.*

BY CHARLES F. SCOTT.

S. D. Warren & Co.'s plant for the production of high grade book paper is located at Cumberland Mills, about four miles from Portland, Me. The mill is a large one, covering many acres of ground, and is noted for the progressive and intelligent methods employed in its management. Some 5 miles below the mill on the Presumpscot River is a water power, having some 10 feet fall with about 1500 available horse-power. At this point machinery is placed for the transmission of power back to the mill. The following brief description of the plant has, in the main, been obtained through the courtesy of Messrs. Stone & Webster, engineers, under whom the plant was constructed.

At the station are two 300-hp two-phase Westinghouse generators, each driven by two 48-inch Victor vertical wheels. The generators are operated in multiple and supply a current at 1100 volts to four 200-hp step-up transformers, which deliver the current at 8000 volts to a three-phase line of bare copper wire by which the power is carried 4 miles to the mill, where the pressure is reduced by four 133-hp step-down transformers to 400 volts for supplying two-phase motors, and an additional transformer of the same size supplies current for lighting. There are seven two-phase Westinghouse induction motors; four 50-hp motors and a 75-hp motor are used to drive pumps and other machinery, and each of two 100-hp motors is direct coupled to a 100-hp direct current generator which furnishes current at 110 volts for electrolytic purposes. (Rotaries could now be used for this work, but were not available when the plant was installed.)

This plant drives machinery in the pulp mill and is also used for an electrolytic process, and arrangements have been made so that the entire mill lighting can be taken from this system if desired, but ordinarily this lighting work is done by a separate plant.

In addition to the transmission plant just described there is also a direct-current transmission of about 250 horse-power from Mather generators, at 500 volts, from a station about a mile up the stream from the mill. This plant was installed prior to the polyphase plant and drives various machinery in the sorting house, and has been used for operating the calenders. All the motors in both systems are belted to short lines of shafting or directly to their work. The standard speeds of belted motors have been found satisfactory. In certain parts of the mill the motors are necessarily exposed to chlorine gas, so that the least possible exposure of brass work or other metal subject to corrosion by these fumes is desirable. The polyphase motors installed about two years ago have not suffered interruption or damage from this source and seem to be entirely satisfactory for the work. It is a serious question whether direct-current motors with their exposed commutators, brush holders, etc., would stand this service satisfactorily. In some parts of the mill there is considerable dampness, but this has not been so excessive as to require waterproof or inclosed motors. The pulp pumps are sometimes jammed and absolutely stopped by pieces of wood which get into the pump cylinders. This necessarily stops the motor, and the characteristics of the alternating-current motors are extremely valuable, as this sudden stoppage does no harm whatever. A direct-current motor if placed in circuit and treated in the same way will be seriously injured, if not burned out, by the very heavy current and the violent sparking which would occur.

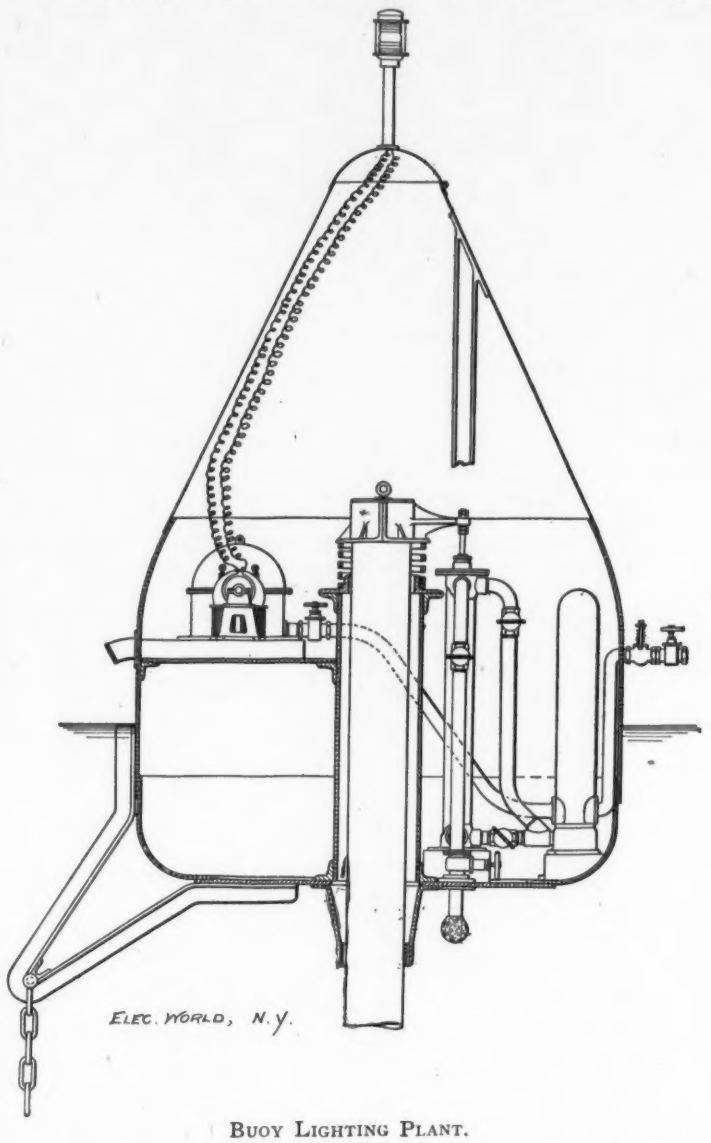
Tests at this plant show an efficiency of 76 or 77 per cent.; that is, for every 100 horse-power mechanical output of the turbines the motors deliver 76 or 77 horse-power to the machinery at the mill. The tests of the power consumed in the pulp mill, before its operation by steam was abandoned and again after the electrical plant had been installed, show a marked and very gratifying saving in the amount of power used, resulting from the more direct application of the power to the machinery and the elimination of the dead load of long shafting, bevelled gears and belts.

It has been found advantageous to divide the motors used into many small units, thereby securing independent control of the different classes of work as well as saving considerable power which would otherwise be lost in long shafting, cross belts, bevelled gears, etc. Induction motors appear to be better adapted for the work than synchronous motors, although the infrequent stoppage of such parts of the work as the electrolytic process, for example, would make the use of the latter permissible.

*Extract from a paper read at the New York meeting of the American Paper and Pulp Association, Feb. 17, 1898.

An Isolated Electrically Lighted Buoy.

An electrically lighted buoy, in which the current for the lamp is generated by a dynamo within the buoy driven by a wave-power hydraulic engine, is described in *Industries and Iron* of February 4. The device is the invention of Mr. D. Morley Fletcher, of London, England, and is being developed by the Morley Fletcher Wave Power System Syndicate, which has been conducting practical trials and tests at sea off Dover. The buoy proper is a plain pear-shaped steel shell, having in its centre a straight steel tube forming the stuffing box of a heavy plunger, the lower end of which is fastened to the anchorage. Attached to a bracket on the top of the plunger



Buoy Lighting Plant.

is the piston rod of a double acting pump, shown to the right of the plunger in the illustration. This pumps water into a reservoir or air vessel, from which it is delivered to a Pelton impulse wheel coupled to a small dynamo mounted on a platform elevated somewhat from the base of the buoy. The buoy shown is about 6 feet in diameter, and is designed to develop at least 5 horse-power on minimum wave motion. The lamp is of only 50 candle-power, so that there is always a large reserve, which is taken care of by a relief valve fitted to the cylinder. Various other details are embodied in the device, such as reserve lights, methods of protecting the dynamo from dampness and means to insure its constant running.

An Extensive Cable Project.

According to the London *Electrician* a proposal has been laid before the British Government by various cable companies to lay a cable from Land's End via Gibraltar, Sierra Leone, Ascension, St. Helena, Cape Town, Mauritius, Rodriguez Island and Cocos Island to Australia. This route is recommended in preference to the proposed all-British-Australia line via Canada. It would touch only on British territory, and would give a triplicate route to both South Africa and Australia. Fourteen thousand miles of cable would be necessary to cover the distance.

The Management of Central Station Meter Systems.

To the Editor of The Electrical World:

SIR:—In the issue of your paper of February 12 I notice a communication from Mr. William H. McDowell, referring to an article in THE ELECTRICAL WORLD, of January 1, by Mr. Caryl D. Haskins, on "The Management of Central Station Meter Systems."

The writer of this communication refers to the difficulty mentioned by Mr. Haskins, which is encountered in using meters of high capacity at points where, during certain hours, only a small number of lamps may be burned. Mr. McDowell suggests the use of "two meters, one of large and one of small capacity, wired to a two-way automatic switch, so that but one would register at a time, the switch being arranged to keep the small meter in circuit with currents less than its capacity, and the large meter with larger currents."

The details of the automatic switch, Mr. McDowell says, he has not worked out, as he considers this a minor consideration.

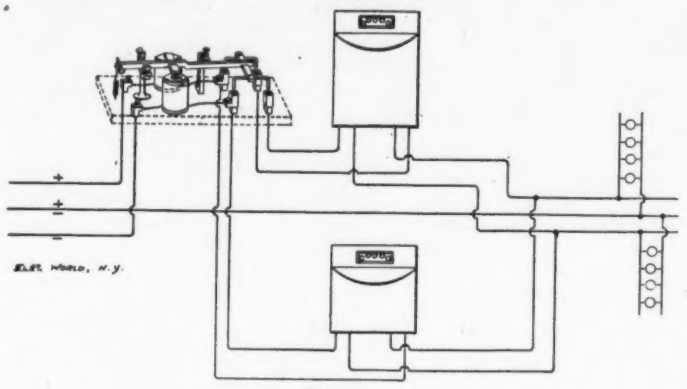


FIG. 1.

It may interest some of your readers to know that this plan has been carried out, even to the perfection of the details of construction. The inaccuracy of large meters when a small number of lamps are turned on, and the frequency with which such meters even refuse to start unless a certain number of lamps are in circuit, are of course well known by all central station men. A few years ago the writer devised the arrangement, shown in Fig. 1, for removing this objection. This consisted of two meters, of different capacities, in connection with an automatic switch having an arm carrying a bar, which is attracted by an electromagnet. The winding of this magnet forms part of the work circuit, so that when the current in the latter increases to a given point the arm will be drawn down and held, closing the circuit of the larger meter through the mercury cups and the conducting yokes carried by the arm. The apparatus, when installed, worked admirably and gave every promise of affording a large saving to the generating companies.

It was found, however, that others had already provided like means for this purpose. A patent, No. 337,123, was granted March 2, 1886, to Borel and Paccaud, which although differing widely in constructive features, disclosed nevertheless the same principle of operation. A single cut, taken from the drawings attached to this patent, will illustrate the close similarity in this respect. It shows (see Fig. 2) three meters, one of which runs constantly, the others being brought into action by an automatic switch controlled by the current. The parts are shown conventionally only, but the mode of operation is clearly apparent.

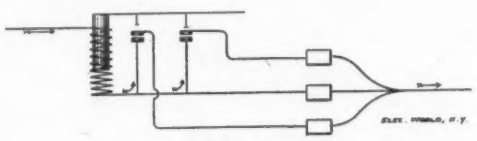


FIG. 2.

In Vol. IV., page 68, of *Electricity* will be found a discussion, also, of a plan proposed before a meeting of the Chicago Electric Club, June 16, 1892, in connection with the Edison chemical meter:

"It was remarked by one of the members of the club, during a discussion of the subject of electric meters, in regard to the electrolytic meter running slow on a light load, that the idea of the Chicago Edison people is to have a meter constructed in such a way that where it is a very large meter that is liable at times to run with light load it will register on two small bottles, and then when a heavier load is thrown on it will be shunted on two larger bottles."

It is doubtful, however, whether the suggestion there made ever bore fruit, for, so far as the writer has been able to learn, nothing more was ever heard of these different sized bottles.

The high degree of perfection to which recording wattmeters have been brought, and the commendable enterprise and wisdom of the manufacturers in adopting promptly every material improvement by which the accuracy and permanent reliability of these instruments can be in any degree increased, will soon, if it does not already, remove the necessity for apparatus of the class I have referred to. It is but a few years ago that meters were almost unknown, and in the comparatively short period since the introduction of the recording wattmeter it has reached a point of perfection in construction that bears evidence of the study and expense that have been devoted to accomplishing the results sought. It is doubtful if the history of invention can furnish a more striking instance of rapid and brilliant success upon novel lines of investigation.

WASHINGTON, D. C. EUSTACE OXLEY.

To the Editor of The Electrical World:

SIR:—Referring to Mr. William H. McDowell's letter in regard to the use of a combination of a large and small meter governed by a two-way switch, the writer has been working on the same thing, off and on, for some years, but has not had the time to devote to it that the problem requires. I must take issue with Mr. McDowell in his statement that the details of the switch are of minor importance, as I should have had the device patented and on the market long before this had it been an easy matter to perfect a switching device for these conditions. The trouble lies in the fact that the control of the device must be made by a magnet in series with the main conductor, and while it must be of sufficient conducting capacity to carry the maximum current, yet it must be so wound that it will act with a small current. This magnet can, of course, be made, and the writer feels that he has about solved the problem. It was at first thought that a form of mercury contact would be the best means of breaking the circuit, as the current was thrown from one meter to another, but it was discarded for a much better method, which uses a new form of switch. This scheme is, to my mind, the ideal way of metering large installations, for by it the large meter is never worked at low loads, where its working is least accurate, while without the switch it is most used at such loads. Another use that could be made of this device is the separating of the two loads from each other and charging for them at different rates, giving a better rate for all power registered on the larger meter, in accordance with the principle of giving greater discounts to customers with larger loads. M. G. STRATTON.

PROVIDENCE, R. I.

Street Railways in Massachusetts.

From the twenty-fifth annual report of the Board of Railroad Commissioners of the State of Massachusetts relating to street railways the following facts of interest have been taken:

The number of railways reported was ninety-three, ten more than in the previous year, four roads having been dropped on account of consolidation and eight new companies having been organized under the general law, four of which are already operating lines. Over 148 miles of single track has been added to the system in Massachusetts by new construction, making the total mileage (single track measurement) 1516 miles; of this 1428 is electrically operated, 186 miles more than the year before. The operation of 12 miles is by horse-power, this being a reduction of 23 miles from the year before.

The cost per mile of main track ranges from about $10,000 in a country town to over $97,000 in the city of Boston. The total income of the companies from all sources for the year ending September 30, 1897, was $15,898,839, the total amount of cash dividends declared being $1,965,243, an increase of $162,396 over the previous year. Fifty out of the ninety-three companies paid dividends ranging from 2 to 10 per cent., and forty-three companies declared and paid no dividends, the highest dividend being 10 per cent., and the average rate of dividend being 6.91 per cent.

The number of electric motors used was 6908, an increase of almost 1000 over the previous year.

The number of accidents to travelers and others was 741, of which seventeen were fatal. The ratio of number of passengers killed to total number carried was about 1 to 31,000,000, and the passengers injured 1 to 246,000, the total number of passengers carried being about 309,000,000.

Digest of Current Electrical Literature

American and Foreign.

by Carl Hering.

Dynamos, Motors and Transformers.

STARTING AND REVERSING RESISTANCES FOR SHUNT MOTORS. Egger. "Elek. Zeit.," Feb. 3.—A long article in the first page of which he replies to the recent article by Menges, and claims priority of invention, giving references. In the second part he describes an apparatus which he devised, and which is now being used; it is based on the fact that it is not only the induction currents which do the damage, but also the sparking of the motor at reduced speed when the circuit is open; moreover, it is often very desirable to reverse the motor quickly; his device answers all these requirements. The sparking due to the opening of the circuit will be less the faster the motor is running, and it is therefore of advantage to open the circuit as quickly as possible; to brake the motor he uses a short circuit in his switch, as also a system of connecting to prevent induction current. When the motor is started a series winding on the magnets is put into circuit, the direction of the current being the same as in the shunt winding; this increases the torque of the motor at starting, and diminishes the starting current; when disconnecting the motor, the armature is short circuited in the fully excited field, the series winding is short circuited, after which the shunt winding is disconnected, and the self-induction in the latter is therefore balanced by the counter inducton in the series winding, thus preventing sparking. Each step in this switch is shown in the succession of thirteen diagrams showing the connecting, disconnecting and reversing of the motor. In conclusion, he refers to some results of tests in an installation where six motors are used for elevators; the currents are given with and without the main series winding, showing that while at full load the currents are the same, those at starting are diminished to nearly one-half when the series winding is used, thus showing its advantage.

PREVENTING SPARKING. Fischer-Hinnen. "Elek. Zeit.," Feb. 3.—A communication in reply to a recent claim of priority by Menges. The only difference between his own apparatus and that of Menges is that in the former the whole starting resistance is in series with the shunt magnets when it is cut out from the armature circuit; he connects one end of the shunt magnets to one pole of the armature, or line, and the other end to the second point of the starting resistance, the first point being the one for open circuit; the magnet winding is therefore always in closed circuit with the armature and starting resistance, and can discharge its self-induction currents through that circuit. He shows that the speed is not materially affected by keeping this resistance in series with the shunt winding; the advantage is that the same apparatus may be used for shunt and series motors, thus simplifying the manufacture; not the slightest sparking occurs in cutting out the motor.

DYNAMO FOR THREE-WIRE SYSTEM. Girault. "L'Eclairage Elec.," Jan. 29.—An illustrated description of an eight-pole 600-hp dynamo which is at present running in the Edison station in Paris, and which is constructed according to the Dobrowolsky system of balancing the two circuits by means of a reaction coil connected permanently to two diametrically opposite points of the armature winding, and which was duly described some time ago.

SINGLE-PHASE MOTORS. Eborall. Lond. "Elec. Rev.," Feb. 4. In this continuation of his series (see "Digest," Feb. 12) he gives his conclusions concerning the single-phase motor with an oscillating field; at starting, two equal and opposite torques are produced, and there can therefore be no initial torque; as the speed is increased the resultant torque rapidly increases; there is a limit of speed before synchronism, at which the torque of the motor again falls to zero; the effect of leakage and self-induction is entirely detrimental. He then begins the discussion of the construction of the single-phase induction motors; this is in general exactly the same as that of multiphasers, with modifications due to the fact that they are not self-starting; the general points to be followed in the electric and magnetic design are given.

POLYPHASE VS. CONTINUOUS-CURRENT MOTORS FOR FACTORIES.—Lond. "Elec. Eng.," Feb. 4.—Answers to the question calling for comparisons of the advantages and disadvantages for the distribution of power in factories.

THEORY OF THE ARNO METHOD FOR STARTING NON-SYNCHRONOUS SINGLE-PHASE MOTORS.—"Bul.. Soc. Int. des Elec.," Dec.—A reprint in full, with the discussion, of his recent paper, which was duly noticed in the "Digest" and in THE ELECTRICAL WORLD. This is reprinted apparently in full in "L'Eclairage Elec.," Jan. 29.

POLYPHASE MOTORS. Boucherot. Lond. "Elec. Eng.," Feb. 4.—An abstract of the paper noticed in the "Digest," last week.

ELECTRICAL GENERATORS. Parshall and Hobart. Lond. "Engineering," Feb. 4.—In his continuation of their serial they give good practical data and comparisons of insulating materials used on dynamos; the information seems to be of a very useful kind.

SHIELDED CONDUCTORS. Price. Lond. "Elec. Rev.," Feb. 4.—A reply to the criticism of Still (see "Digest," last week); he puts the matter into a simpler form. Regarding the criticisms of his paradox, he states that a magnet is not the seat of magnetic force, but a source of magnetic flux, and it is therefore not comparable with a dynamo.

TORQUE AND SPEED OF MOTOR. Milne. "Can. Elec. News," Feb.—A short mathematical paper of an elementary nature showing how these may be calculated. (One of the results, however, is very misleading.)

Lights and Lighting.

ENCLOSED ARC LAMPS.—"Zeit. f. Beleucht.," Jan. 20.—An illustrated description of the Koerting and Mathiesen lamp, with some data. The issue of Jan. 10 contains an illustrated description of the Jandus lamp, as made in Brussels.

CANDLE-POWER OF THE ARC LAMP. Marks. "Elec. Rev.," Feb. 16.—An article in which he discusses the subject of what the candle-power of a 10-ampere, 45-volt open lamp is. There are at least five ways of stating the candle-power—the nominal, horizontal, maximum, mean spherical and mean hemispherical; according to the first it is 2000. He then calls attention to the effect of the quality of the carbon, which may make a difference of over 80 per cent. in the mean spherical candle-power; it will depend largely on their cross-section; the effect of reflected light must be taken into consideration; it should be stated whether a globe is used and what its absorbing power is; there is furthermore the personal error in the measurement, and it is a question what standard is used; the term candle-power of an arc lamp is therefore almost meaningless. Some measurements by him and others are given, showing that the horizontal candle-power of such a lamp is 227 to 456, the maximum 1080 to 2000, the mean spherical 425 to 653, and the mean hemispherical, 600.

PREVENTING THE FREEZING OF ARC LAMPS. Fowden. "Elec. Eng.," Feb. 10.—A note stating that if a number of thin sheets of cardboard, with holes punched in them the size of the carbon, be slipped on the upper carbon on the early side of the lamp, they will act as a shed for the water, and in only very few cases will the lamp freeze.

Power.

LARGE TRANSMISSION OF POWER PROJECT.—"Zeit. f. Beleucht., Dec. 30.—A note stating that a project is under consideration for utilizing the power of the Sihl, in Switzerland, from which 17,000 horse-power could be developed continuously, or 40,000 intermittently.

ELECTRICITY IN AGRICULTURE. Wurtzler. "Elek. Zeit.," Feb. 3.—An abstract of a recent paper on improving agricultural facilities by electrical devices. He considers the best method of ploughing to be the one using two machines, one on each side of the field, drawing the plough by means of a cable; in the discussion Heinzerling claimed that the three-phase motor was very well adapted for this kind of work.

CONTINUOUS AND THREE-PHASE CURRENT FOR POWER TRANSMISSION. Schultz. "Elek. Anz.," Jan. 23 and Feb. 3.—Two articles, in the first of which he points out the advantages of three-phase currents for high voltages, and in the second he describes two successful installations.

UTILIZING THE WATER-POWER OF SMALL FALLS.—"Elek. Anz.," Jan. 30.—An illustrated article, calling attention to the availability of a very simple wheel made in the form of a screw plate, and traveling rapidly as a reaction wheel.

DUST DESTRUCTORS.—The Lond. "Elec.," Feb. 4, contains an editorial criticism of the recent report in connection with the dust destructor at Leyton, which was recently exhibited. It is stated that until certain figures are given it is impossible to judge between this plant and others. An editorial in the Lond. "Elec. Eng.," Feb. 4, quotes a paragraph from the report giving the detailed results of the trial. Lond. "Lightning," Feb. 3, also discusses it briefly. In the Lond. "Elec. Rev.," Feb. 4, there is also a brief account of the discussion of the proposed works at Gloucester. Also parts of a recent paper by Liversedge before the Gloucester Engineering Society. Also a long communication from Jones on the subject of refuse destructors.

50,000-VOLT TRANSMISSION AT TELLURIDE.—"Elec. Eng.," Feb. 10.—A note stating that 50,000 volts was tried for two weeks with three-phase currents without accident; the line consisted of galvanized iron telegraphic wires, supported on glass insu-

lators; the self-induction of the iron wire had a beneficial effect in counteracting the capacity of the line, which is 3 miles long.

POWER TRANSMISSION PLANT.—"Jour. of El'ty," Jan.—A short illustrated description of the plant in the Chollar shaft on the Comstock, constructed in 1891, which is now of historical interest.

Traction.

POLYPHASE MOTORS FOR TRACTION.—Lond. "Elec.," Feb. 4.—An editorial discussion. It is shown that the fixed losses in the transmission would become considerable; collector rings would be necessary for controlling, and these are to some extent as objectionable as commutators. It is concluded that the induction motor is usually only suited for those systems in which long runs can be made at a constant speed; it is thought that there is only a very limited field for the induction motor for traction.

TESTING RAILWAY CIRCUITS WHILE RUNNING.—"Elek. Zeit.," Feb. 3.—A long illustrated abstract, accompanied by a discussion, of the article by Porter, in THE ELECTRICAL WORLD, July 17, p. 61, and showing that the methods follow from the general propositions of Kallmann; the methods described by Porter are well spoken of.

TRAVELING PLATFORM. Reyval. "L'Eclairage Elec.," Jan. 29.—A long illustrated article showing a number of different systems, with special reference to the two-speed system of Blot, Guyenet and Mocomble, which it appears is to be used at the Paris Exposition of 1900.

BRUSSELS AND OSTENDE. Ziffer. "Elek. Anz.," Jan. 27.—An abstract of a recent report of a visit to the street railway lines.

ELECTRIC MAIL VAN.—Lond. "Elec.," Feb. 4.—A brief illustrated description of the one used in the British post office in London; it makes six journeys a day, covering a total of 35 miles; the total weight of the battery is about 15 cwt.; it is charged once a day; the maximum speed is 10 to 12 miles an hour.

ELECTRICAL CAR HEATING. Verole. "Zeit. fuer Elek.," Jan. 30.—An abstract of a recent paper from a Belgian railroad journal, in which he discusses the practicability of electrical heating. He concludes that it is not feasible on railroad cars which are lighted electrically; he makes some calculations for street railways driven by accumulators, finding that an extra weight of 510 kg of accumulators would be required, and an increased discharging current of 26 per cent; owing to the reduced traffic in winter electrical heating might be used. For trolley cars there is no doubt that electrical heating is advisable; the energy lost in the starting resistance might be used; this method is largely in use on the electric line in Vienna.

CAR ACCELERATION.—Cravath. "Elec. Eng.," Feb. 10.—A brief discussion of the question of rapid acceleration. That commonly used in street railway practice is excellent and much more rapid than in any other branch of railroading except on cable roads; a 15,000-pound single truck car having two motors of 25 horse-power each, geared to run 16 to 18 miles an hour, can be started and brought up to speed in about 12 seconds on a dry and clean track; this represents an acceleration of 1.5 to 1.33 miles per hour per second; the current is 60 to 70 amperes; on elevated roads the proposed rate of 2 miles per hour per second is no doubt feasible, but whether such a rapid acceleration is worth what it will cost is the problem which must be decided; the outlay will be far beyond anything hitherto known; some figures are given briefly; an acceleration of 30 miles an hour in 15 seconds is about three times the common practice on the elevated roads in Chicago; the amount of heat generated during acceleration will be three times as great as on the West Side road in Chicago; four to five times the motor capacity will be required; the faster the acceleration, the less the number of trains for a given service; the power plant would be double, and the increase in feeder lines still greater; either the Sprague multiple unit system, or a heavy motor car pulling only one trailer, must be used; the former has a low efficiency, both electrically and mechanically, and is therefore costly to operate, beside involving a heavy investment for the motors and devices. He gives somes figures to show the effect on the schedule of an acceleration of 30 miles an hour in 15 seconds on a road where the present practice is 30 miles in 45 seconds.

ELEVATED RAILWAY.—"Eng. News," Feb. 17.—A note stating that it is proposed to erect an elevated railway for surface cars on Dearborn street, Chicago, where there is often a congestion of traffic, which this is intended to relieve; it involves a grade crossing with the elevated loop lines.

CABLE WAY.—"Eng. News." Feb. 17.—A note stating that an electric cable way along the Champlain Canal, 30 miles long, is to be constructed.

ELECTROLYSIS OF WATER MAINS AND CABLES.—"Eng. News," Feb. 17.—A note stating that the matter is attracting attention in Washington, where currents of 4 and 6 amperes were found in and between pipes.

Installations, Systems and Appliances.

SYNCHRONIZING ALTERNATORS. Kensit. Lond. "Elec.," Feb. 4—In paralleling alternators it is necessary to ascertain whether the synchronizing transformers are so connected that the alternators are in phase when the lamp is bright, for if not, the incoming machine is opposed to the loaded machine; this is sometimes found out by the trial and error method through fuses. In the present arrangement he describes a safe way, which is so simple that he thinks it ought to be put in universal use; it is shown with the aid of diagrams. When the transformers are across only one coil the transformer of the loaded machine is disconnected and is then connected to the incoming machine, being careful to connect it in the same way; if the lamp is then bright it will also be bright when the alternators are in phase, but if not, the leads of the transformer of the incoming machine should be reversed. When the transformers are connected across the alternator terminals, take out the fuses of the incoming machine and connect the transformer to the bus bars; if the lamp is bright all is ready for paralleling. When a machine is to be paralleled with a synchronizing transformer fed from only one coil on one, and from the alternator termisals on the other, then neither method will do, and the temporary use of another transformer is necessary; this temporary transformer is then used first with one machine and then with the other. In his extended experience he has never been able to detect that it makes any difference in synchronizing an alternator when the speed is being raised than when it is being decreased, it being often stated that the former is better; he considers a Cardew voltmeter the most satisfactory instrument for synchronizing; it is undoubtedly worse to be too late than too soon in closing the switches for paralleling.

OXFORD SYSTEM. McLean. Lond. "Lightning," Jan. 27.—A short article on some of the later features in this system, which is now considered to be a recognized economical method of distribution; it is a high tension continuous current system with the use of rotary transformers. The flexibility of the system enables a complete control to be had from a central spot, which is preferably at the generating station instead of at a switching station; the currents generated at 1 to 2,000 volts can be distributed directly for traction purposes on a three-wire system with 500 volts to a side; batteries are used at Oxford to do the lighting for the night, thus avoiding one shift of men; the variable ratio transformer, which is illustrated, is considered an important improvement; it contains two sets of magnets with a common armature, and separates the primary and secondary windings so that each may be independently controlled.

LIGHTING AND TRACTION STATION IN DOVER.—Lond. "Lightning," Feb. 3.—A brief illustrated description of this combined station, where alternating currents are used for lighting; it seems that the boilers are the only parts in common beside a 30-kw motor alternator for converting alternating into direct current, or the reverse; a battery is also used.

RENTING MOTORS AND LAMPS.—Lond. "Elec.," Feb. 4.—An editorial note stating that the Bradford station, which is owned by the municipality, is renting motors, lamps and electric heating and cooking apparatus to consumers; the charges are given.

HAMBURG.—"Elek. Zeit.," Feb. 3.—A long extract from the report of the operation of this station for the year ending June, 1897.

BRIGHTON SYSTEM OF CHARGING.—Lond. "Elec. Eng.," Feb. 4.—Discussions of this system from the consumer's standpoint.

GLASGOW RAILWAY LIGHTING PLANT.—Lond. "Elec. Eng.," Feb. 4.—A continuation of a long illustrated description noticed in the "Digest," Feb. 12.

SYNCHRONIZING TWO-PHASERS.—"Jour. of El'ty," Jan.—A short illustrated discussion. There is no doubt that the preferable time of throwing a switch is at the moment of maximum brilliancy of the lamps, instead of at the moment of their extinguishment, the reason being that the slight variation in voltage is then far more readily noticed. The method used by the Blue Lakes Water Company is described; the leading phase only is used.

STORAGE BATTERY PLANT.—"Eng. News," Feb. 17.—A note stating that what will be the largest storage battery plant in the world, being about 70 per cent. larger than any other, is to be installed in the plant of the Chicago Edison Company. There will be 166 cells, of a capacity of 11,200 ampere hours for a 1.25 hour discharge, and double this for an 8-hour discharge; it will discharge at two different voltages, enabling certain long feeders to be used; it dispenses with the booster.

THE MOTOR BUSINESS. Harlow and Barstow. "Elec. Eng.," Feb. 10.—Some questions regarding the motor business of central station by the former and answered by the latter.

LIGHTING AND RAILWAY STATISTICS IN THE UNITED KINGDOM.—"Elec. Eng.," Feb. 10.—A reprint in part of the statistics noticed in the "Digest," Jan. 29.

PROTECTION AGAINST LIGHTNING. Wurtz. "Jour. of El'ty," Jan.—A reply to the recent queries of Sutcliffe in the article noticed in the "Digest," Dec. 25.

MUNICIPAL OWNERSHIP.—"Elec. Eng.," Feb. 10.—A reprint of a report against municipal ownership of street railways in Massachusetts by a special committee. Also a note on municipal power over franchises in Illinois. Also other articles which have already been noticed.

ANNUAL REPORT OF THE NEW YORK EDISON COMPANY.—"Elec. Eng.," Feb. 10.—An extract and editorial discussion of the recent report.

PRACTICAL REPAIR HINTS. Fells. "West. Elec.," Feb. 12.—A short illustrated article giving a few hints regarding repairs.

Wires, Wiring and Conduits.

OVERHEAD WIRES.—"Eng. News," Feb. 17.—A note stating that a bill is about to be passed in Washington compelling all overhead wires to be placed underground. Another note states that the mayor of Chicago has issued an order to that effect in that city, affecting some 4000 overhead wires.

MERCURY CUT-OUT.—"Elek. Anz.," Jan. 27.—A well illustrated description of a form in which the iron core plunger works in mercury in closed tubes, the contact being broken only by the mercury.

CHANGING INSULATORS ON LIVE LINES.—"Jour. of El'ty," Jan.—A summary of the answers received from the principal installations on the Pacific Coast, regarding this subject, prompted by the article noticed in the "Digest," Nov. 20. The prevailing practice is never to change an insulator, or have anything to do with a high tension wire while the current is on; Sutcliffe claims that it has not been found necessary to change insulators on live lines; Hutton's method is to shut off the current, taking the additional precaution to short-circuit and ground the line on which the men are at work; in the Big Cottonwoods plant the custom is to shut down absolutely between 12 and 1 on Sundays; the entire line is inspected twice a month during stormy weather, if possible, as leaky insulators are then easily determined by the light produced.

MULTI-GLAZE INSULATORS.—"Jour. of El'ty."—An illustrated description of the Boch insulator for extremely high voltages. It is made of three shells each fitting the other closely; they are glazed separately, then put together and secured by a thin layer of melted glass, thus making six skins of glaze and two layers of glass between the wire and the pin.

Electro-Physics and Magnetism.

ANALOGY BETWEEN CATHODE AND RONTGEN RAYS. Batteli. "Phil. Mag.," Feb.—Thompson some time ago concluded that there is another special kind of ray; similar experiments made previously by the author led him to believe that Röntgen and cathode rays were of an identical nature, but that the first only constituted a part of the latter; he states that Thompson's experiment agrees with this hypothesis without necessarily involving a third species of ray; other experiments which he describes are more in harmony with this than with Thompson's hypothesis; these he describes at length and concludes that it cannot be asserted that cathode rays are reflected as a whole according to the laws of regular reflection; that the rays thrown back from a reflector may confidently be assumed to possess the same properties as the direct-cathode rays; that the rays from the back of a very thin sheet struck by cathode rays also possess the same properties; that a beam of cathode rays appears to be made up of various rays of different natures, and when they strike a thin substance they seem to pass through it as though through a filter, which enables some but not others to pass.

THEORY OF CONNECTION BETWEEN CATHODE AND RONTGEN RAYS. J. J. Thomson. "Phil. Mag.," Feb.—A mathematical article in which he calculates the magnetic force and electrical intensity carried by an electrical pulse to any point in a dielectric, and he concludes from the effects of the sudden stoppage of electrified particles that Röntgen rays are produced by a very thin pulse of intense electro-magnetic disturbance, and that Röntgen rays are not waves of very short wave length, but impulses.

RESISTANCE OF THE CATHODE SPACE. Wiedmann. "Wied. Ann.," No. 13; noticed briefly in the Lond. "Elec.," Feb. 4. He made experiments to determine the cause of the increase of resistance of the rarefied gas when the anode is brought very near to the cathode. He found that the discharge proceeds from the positive light to the negative glow and thence through the dark space.

VACUUM DISCHARGES IN A MAGNETIC FIELD. Paal-'zow and Neesen. "Wied. Ann.," No. 13; noticed briefly in the Lond "Elec.," Feb. 4.—Tehy examised the effect of the magnetic field chiefly on the current strength, using their constant high potential battery and a tube in the form of a cross with an electrode in each of the four branches. The magnetic field acted like an increase of the pressure of the gas unless the cathode itself was exposed to the field.

RONTGEN RAY TUBES. "L'Eclairage Elec.," Jan. 29.—A brief description, without an illustration, of some simple forms of tubes devised by Guglielmo.

RADIOGRAPHY BY MEANS OF STATIC MACHINES. "Cosmos," Jan. 8.—Some notes based on the experience of several experimenters who used them.

CHANGE IN SALTS BY CATHODE RAYS. Abegg. "Proc. Lond. Phys. Soc.," Dec.—An abstract of the article noticed in the "Digest," Dec. 4.

ELECTRICAL PROPERTIES OF NEWLY PREPARED GASES. Townsend. "Phil. Mag.," Feb.—A very long article describing experiments, which were a continuation of those already reported. It was shown that the gases in the electrolysis of sulphuric acid and caustic potash carry with them an electric charge, a large portion of which remains with the gas after it leaves the liquid and drying wool; it has the power of condensing moisture to form a cloud; this proves that the drops are formed around the carriers of the electric charge and the results were used to find the charge on each carrier.

ELECTRICAL HYPOTHESIS OF THE SOLAR SYSTEM. Delta. Lond. "Elec. Rev.," Feb. 4.—A continuation of the article noticed in the "Digest," Feb. 12.

MAGNETIC WIND. Lehmann. "Wied. Ann.," No. 13; abstracted, with an illustration, in the Lond. "Elec.," Feb. 4.—A description of an investigation of a phenomena of electric and magnetic wind, which seems to be contrary to theory. The abstract is reprinted in "El'ty," N. Y., Feb. 16.

ZEEMAN EFFECT.—The following list of articles appears in the journals this week: One on a simple demonstration of the Zeeman effect by Koenig, in the "Wied. Ann.," No. 13; noticed briefly in the Lond. "Elec.," Feb. 4; he showed an effective way of exhibiting the phenomena in a very simple way. The "Phil. Mag.," Feb., contains a short article by Zeeman on measurements concerning radiant phenomena in the magnetic field. The Lond. "Elec. Eng.," Feb. 4, contains a short article by Edger giving a simple explanation of this phenomenon. "L'Eclairage Elec.," Jan. 29, contains a description of the interesting experiments of Cotton. Also a notice of an article by Koenig from the "Wied. Ann.," 62, p. 240. Also an article by Cornu on some new results regarding this phenomenon. The "Rev. Gen. des Sciences," Dec. 30, contains a letter by Broca supplementary to his recent article in that journal.

MAGNETIC IMAGES. Jaeger. "Wied. Ann.," No. 13; noticed briefly in Lond. "Elec.," Jan. 28.—He examined the case of a constant current traversing a conductor in the neighborhood of a plate in order to study the "magnetic images" pointed out by S. P. Thompson, some years ago. The field as modified by the plate was identical with that produced by the original coil and its image in the plate.

PERIODIC CHANGES OF THE EARTH'S MAGNETISM. Eschenhagen. "Terrestrial Magnetism," Sept.—A long article on minute, rapid and periodic changes, with special reference to the atomic registration instrument used at Potsdam, the results of which are very accurate.

RONTGEN RAY NOTES. Rollins. "Elec. Rev.," Feb. 16.—In this continuation of his very long serial he states that another reason why the vacuum rises is that the residual oxygen molecules are "smashed" and that the molecules therefore contain more atoms and become less in number, increasing the vacuum; they are then decomposed by heat. He claims that the wave length depends upon the molecular weight of the bombarding molecules and that therefore the gas and metal should be tuned to strike the target with the same velocity; this gives a method of determining the molecular weight. He shows why hydrogen and argon are not suited when the cathode is aluminum; also that bad definition is caused by the dancing of the radiant point.

X-RAY PICTURES. "Elec. Eng.," Feb. 10.—A reprint of a short article from "La Nature," by Buguet, showing a picture of a rifle and stating that for radiographs of very opaque objects, requiring a very long exposure and powerful tubes, it is expedient to use a sensitive preparation of loose films of commercial gelatine and lay them on sheets of lead of the same shape, enclosing the whole in black paper; the use of the black screen brings out the details better.

EFFECT OF RONTGEN RAYS ON PLANTS. Atkinson. "Elec. Eng.," Feb. 10.—A brief abstract of the article mentioned in the "Digest," Jan. 22.

NEW THEORY OF ELECTRICITY. Gross. "El'ty," Feb. 16.—A brief mention of a recent newspaper article in which he claims to have revolutionized the method of producing electricity; he intends to "capture" and utilize the "earth-seeking electricity"; he claims that the earth in revolving generates a powerful current and that his apparatus for generating it will have proportionately greater centrifugal force than that of the earth. He does not pretend to be an electrician.

HIGH E. M. F. Trowbridge. "West. Elec.," Feb. 12.—A reprint of the article, with illustrations, noticed in the "Digest," Jan. 29.

EARTH'S MAGNETISM. "Terrestrial Magnetism," Sept.—The results of some observations at an observatory in Lisbon. Also a chart from the Maryland Geological Survey, showing the secular variations between 1700 and 1900 A. D., according to Schott; also a plate, by Bauer, from the same source, showing the characteristic features of the secular variations in the northern hemisphere. Also a list of published papers on terrestrial magnetism and meteorology by Chambers.

INCLINATION DURING THE ETRUSCAN PERIOD. Carlheim. "Terrestrial Magnetism," Sept.—A short article in French, in which he deduces theoretically an equation and curve for the probable value at this period with special reference to the figures in Italy. The results for that period show that the inclination could never have passed zero at that time, which does not agree with the determinations of Folgheraiter on vases.

ERRORS IN MEASUREMENTS OF EARTH'S MAGNETISM. Wild. "Terrestrial Magnetism," Sept.—A long article in German pointing out the precautions which an observer should exercise in such measurements in order that the accuracy of the results may be correctly understood; he refers at length to the measurement of the absolute intensity of the horizontal component, an op-

eration which consumes so much time that the constancy of this quantity cannot be depended upon during the determination.

NON-CYCLIC EFFECT. Chree. "Terrestrial Magnetism," Sept.—A brief reply to the article of Bemmelen noticed in the "Digest" last week.

Electro-Chemistry and Batteries.

ELECTRO-CHEMICAL TREATMENT OF ORES CONTAINING PRECIOUS METALS. Webber. Lond. "Elec. Rev.," Feb. 4.—A long abstract of his paper (see "Digest," last week); the discussion is also given briefly. The reprint in full is concluded in the Lond. "Elec. Eng.," Feb. 4, including a number of illustrations; the discussion is also given.

ELECTRO-CHEMICAL EQUIVALENT OF CARBON. Coehn. Lond. "Elec. Eng.," Feb. 4.—A brief abstract, giving the conclusions of his recent paper. When carbon is the anode in electrolysis of liquids evolving oxygen it is not only mechanical disintegration but also chemical acted upon, the nature of the action depending on the electrolyte; there is less mechanical disintegration at higher temperatures; a determination by loss of weight of carefully purified carbon gave 3.5 as the actual chemical equivalent, although some mechanical loss had occurred; other determinations varied from 2.7 to 3.0; this is independent of the concentration or temperature.

RELATION BETWEEN CHEMICAL AND ELECTRICAL ENERGY. Klaudy. "Zeit. fuer Elek.," Jan. 30.—The first part of a recent paper read before the Vienna Electrical Soceity; it is of a theoretical nature.

CALCULATIONS OF THE CONDUCTIVITY OF ELECTROLYTES. MacGregor and Archibald. "Phil. Mag.," Feb.—A short article on the calculation of the conductivity of aqueous solutions containing two electrolytes with no common ion.

RIBBE ACCUMULATORS.—"Elek. Anz.," Jan. 23.—An illustrated description of these accumulators, the pasted plates of which are covered on both sides by perforated celluloid; celluloid having little nitrogen has been found to stand the effects of the acid for three years.

LAMINA ACCUMULATOR.—"Elec. Eng.," Feb. 10.—A brief illustrated description of these accumulators as made in England.

Units, Measurements and Instruments.

WORK OF THE IMPERIAL REICHSANSTALT.—"Elek. Zeit.," Feb. 3.—The first part of a general report of the work of that institution for the two years ending last summer, the report being limited to the electrical and magnetic subjects. Regarding standard resistances much work was done in connection with the standard ohm and this may now be considered concluded, the determination of the ohm for that institution being now assured. Comparisons were made to determine the constancy of the wire and mercury secondary standards, which have been repeatedly compared and gave very good results, as before; those of wire are almost all of manganin and show that this material beside having a very small temperature coefficient has a very good constancy and is therefore well suited for exact measurements. Under standard cells it is stated that both the Clark and the Weston cells were carefully examined, and the previous results were confirmed that the cells are constant and reproducible to 1 in 10,000; the dependence of the voltage of the cadmium cell on the composition of the amalgam was also investigated; also the effect of warming the cells. An absolute determination of the Clark cell was made with the Helmholtz electro-dynamometer, it being a repetition of the previous one; the results differed by less than 1 in 1000 from the values obtained with the silver voltameter and showed that the absolute measurements of current agreed with those made by other methods. The determination of the E. M. F. of the Clark cell with the silver voltameter showed the difficulties involved, and if these are not taken into account the results are uncertain to 1 in 1000. The magnetization of iron and steel in weak fields was investigated, and with annealed and hard cast steel and with cast iron a straight line relation was found, while for hard and soft wrought iron the relation was not so simple. The electric conductivity of solutions was also examined and the results show that the electric current is very suitable for scientific research with solutions and in chemistry, being in some respects superior to other methods in analyses.

DETERMINING THE EFFICIENCIES OF DYNAMOS. Ashworth. Lond. "Elec.," Feb. 4.—He states that the method of Routin (see "Digest," Feb. 5,) is the same in principle as one he described in 1893. A brake, however, is not very reliable and the present writer therefore suggested to find the value of that quantity by attaching to the armature a fly wheel of known moment of inertia; the formula for that case is given.

FAILURE OF GERMAN, SILVER AND PLATINOID WIRES. Appleyard. "Phil. Mag.," Feb.—A reprint in full of the Physical Society paper noticed in the "Digest," Dec. 25.

THOMSON-VARLEY BRIDGE. Tobler. "Jour. Telegraphique," Jan. 25.—An article on this bridge, chiefly of a historical nature, but including an explanation of it with diagrams and examples.

ABSOLUTE ELECTRO-DYNAMOMETER. Kahle. "Elek. Zeit.," Feb. 3.—A long illustrated description of the Helmholtz form and its application, reprinted from the "Zeit. f. Instrumentenkunde," No. 4, 1897.

POTENTIOMETER.—Lond. "Elec.," Feb. 4.—An illustrated description of the new form of the N. C. S. instrument.

OBSERVATORY AT PARCSAINT-MAUR.—"Cosmos," Jan. 1.—An illustrated description of this observatory near Paris, showing also the Mascart new collector for atmospheric electricity. In the issue of Jan. 15 Demichel refers briefly to another registering apparatus.

Telegraphy, Telephony and Signals.

SIGNALLING WITHOUT CONNECTING WIRES. Lodge. Lond. "Elec. Rev.," Feb. 4.—An abstract of his Physical Society paper, which was noticed in the "Digest" last week. A longer abstract, with quite a number of illustrations, is given in the Lond. "Elec. Eng.," Feb. 4.

WIRELESS TELEGRAPHY. Poincare. "Rev. Gen. des Sciences," Jan. 30.—A long article on the transmission of energy to a distance through the natural media; it is a sort of synthetic examination of the question of wireless telegraphy, concluding with diagrams of the producer and the receiver.

SUBMARINE CABLE REPAIRS. Gray. Lond. "Elec.," Feb. 4.—A communication, giving a table showing the relation between the depth of the water length of the suspended bight with various percentages of slack; this is used for determining the length which must be renewed when the cable has been dragged over the bottom in the course of repairs.

PACIFIC CABLE. Fleming. Lond. "Elec. Rev.," Feb. 4.—The beginning of a reprint of a long letter to Sir Wilfred Laurier.

TELEGRAPH AND TELEPHONE STATISTICS.—"Jour. Telegraphique," Jan. 25.—Extracts from the official statistics for 1896 for Germany and for 1896 and part of 1897 for Great Britain.

SUBMARINE CABLE LAYING.—"Elec. Rev.," Feb. 16.—An illustrated description of the recent laying of the cable to Fire Island, in which great difficulties were encountered; the cable was the heaviest of the kind ever manufactured, and is 6 miles long.

ELECTROLYTIC PHONOGRAPH.—"Elek. Zeit.," Feb. 3.—A brief editorial description and discussion of the suggestions of the late Kiliani for the construction of such a phonograph. His idea was to record on photographic plates by electrolytic action the words spoken through a microphone; two electrodes passed over the sensitive phonographic paper and the microphone current is passed from one to the othe, decomposing the salts at the contact in proportion to the strength of the current. There was no description in the papers which he left showing how he intended to reproduce the sound waves from this record, but the editorial describes two ways in which this might be possible; one is to let light pass through the plate on to a rod of selenium in series with the battery and telephone. The experiments as far as they were recorded are briefly described; although they were not sufficient to be used as a foundation for further work, it is thought that they show that the object could be accomplished in the proposed way.

CARBONS FOR ELECTRIC LIGHTING AND OTHER PURPOSES. Jehl. Lond. "Elec.," Feb. 4.—The first part of a serial, taken from a forthcoming book; he begins by giving the properties of carbon, gives some historical notes and will then give descriptions of the modern processes by which electric light carbons, electrodes and battery plates are manufactured.

DIRECT TRANSFORMATION OF HEAT INTO MECHANICAL WORK. Deprez. "Rev. Gen. des Sciences," Jan. 30.—An article supplementary to the recent one suggesting the pyroelectric method of converting heat into electric energy by means of the magnetic alloys of nickel and iron; in this it appears that great difficulties are encountered; in the present article he suggests transforming the heat into mechanical energy in a similar way; his conclusions seem to show that great difficulties are also encountered, but he suggests means for ameliorating them.

ELECTRO-THERAPEUTICAL APPARATUS. Courmelles. "Bul. Soc. Int. des Elec.," Nov.—A reprint of a long paper, describing and discussing some apparatus.

BIOGRAPHICAL.—Lond. "Elec.," and "Elec. Rev.," Feb. 4.—A short biographical sketch of Lord Sackville Arthur Cecil; also of Charles William Strong, both of whom died recently.

EDUCATIONAL. Janet. "Bul. Soc. Int. des Elec.," Nov.—A short illustrated description of the work done by the students in the High School for Electricity. The same journal contains an illustrated description of the principal methods of measurement used in the laboratory of that society.

EFFECT OF ELECTRICITY ON MODERN BUILDINGS. "Can. Elec. News," Feb.—A short article, in which attention is called to the effect of induced and leakage currents in the massive steel framework of modern buildings, in which electric wires are used. As the steel frame has a comparatively low resistance the currents may become quite great and the electrolytic damage may be considerable; this can take place not only in the steel frame, but in the piping; it is worse with alternating currents; it may loosen the joints, which will promote decomposition with the assistance of moisture; electrolytic injury would take place at the base. He recommends thoroughly grounding the entire steel structure by copper

wires of large section making good connection with permanently moist soil; all wires carrying main currents should be as far removed from the structure as possible.

EFFECT OF HIGH VOLTAGE ON AN ANIMAL.—"Jour. of El'ty," Jan.; reprinted in "Elec. Rev.," Feb. 16.—An illustration of the remains of two eagles which caused a short circuit of a 10,000-volt line.

WELDING, SOLDERING, ETC.—"Elec. Eng.," Feb. 10.—An illustrated description of the Voltex process, which was noticed in the "Digest," Dec. 18.

VISIT TO SCIENTIFIC INSTITUTIONS IN EUROPE. Morley.—"Sc. Am. Sup.," Feb. 19.—A long abstract of a recent paper read before the Civil Engineers' Club of Cleveland.

BIOGRAPHICAL.—"West. Elec.," Feb. 12.—A short biographal sketch with portrait of Louis A. Ferguson.

PRIZE.—"El'ty," Feb. 16.—An announcemest of a first prize of $25 and a second of $15, offered for the most meritorious thesis sent to that journal by students graduating this year.

High Pressure Insulator of New Construction.

The illustration shown below represents a high pressure insulator manufactured by Mr. Fred M. Locke, Victor, N. Y., which has been the subject of an interference case in the United States Patent Office. A decision in the case has just been rendered by the examiner, and promulgated by C. H. Duell, Commissioner of Patents. It is in favor of Mr. Locke and against Boch, who asked for the dissolution of the interference.

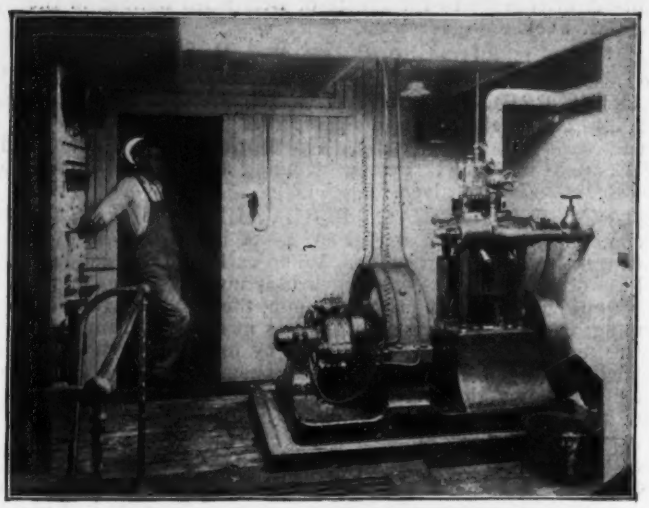
The insulator in question, as constructed by Mr. Locke, is made of three shells of vitrified china, fused together. The illustration also shows a steel pin, with porcelain base, which is being generally adopted on high voltage power transmission lines. It is stated that the sleeve on the pin increases the arcing distance by at least 10,000 volts. In the event of arcing on such an insulator, however, there is no danger of ignition and consequent destruction by fire of the pin and pole. Pins and poles have in some cases been destroyed by fire as a result of short circuits between the insulator and pin.

The Electric Plant of the Diamond Shoal Lightship.

For three months past Lightship No. 69 has been anchored off Cape Hatteras in 30 fathoms of water, and proved to the satisfaction of the Lighthouse Board that a light vessel can be safely maintained at that perilous spot. The electrical features of this vessel are interesting. The night electric lights are suspended at the heads of the two steel masts, and are surrounded by a gallery for day signals.

To avoid chance of breakdown the electric plant is in duplicate. The plant consists of two marine generating sets, with dynamo and engine, both built by the General Electric Company, Schenectady, N. Y. The four-pole dynamos are 8-kw 650-revolution machines, directly connected to 4½-inch x 4-inch double cylinder engines. The switchboard is of Vermont marble, and the wiring appliances used throughout are of the type approved by the United States Naval Board of Inspection. The dynamos furnish 100-volt current to eight 100 candle-power lamps, four at each masthead, and forty 16 candle-power lamps throughout the vessel. The masthead lights are each enclosed in a lens lantern, three being used and the fourth held in reserve. Connected in circuit to the masthead lights is a device making and breaking the circuit and lighting and extinguishing the lamps at regular intervals. A fixed white light shows for twelve seconds, and is followed by an eclipse of three seconds. The focal plane of the lights is 57 feet above the sea and they are visible 13 nautical miles away in clear weather. Great reliance is placed upon the electric plants, and in their construction more than ordinary care has been taken, on account of possible consequences of a breakdown through accident.

Lightship No. 68, which does sentinel duty off Fire Island, is a counterpart of No. 69. Both vessels are 122 feet 10 inches long over all, 29 feet 6 inches beam and 23 feet moulded depth. They are provided with propelling machinery. Two vertical donkey boilers furnish steam for the electric lighting plant, windlass pumps, fog signals and for heating.



Electric Generating Plant on the Diamond Shoal Lightship.

Electric Percussion Drill.

A percussion drill for mining and other rock drilling work is shown in the accompanying illustrations. The machine is so simple and its principle such a neat application of scientific laws that it is well worth investigation, even by those not interested in mining work.

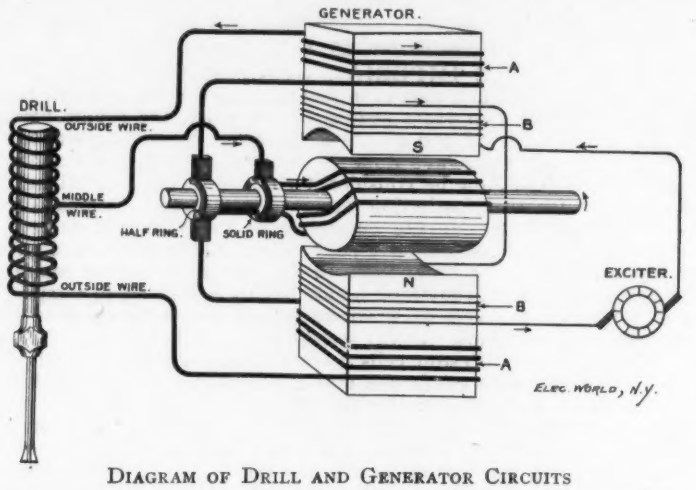
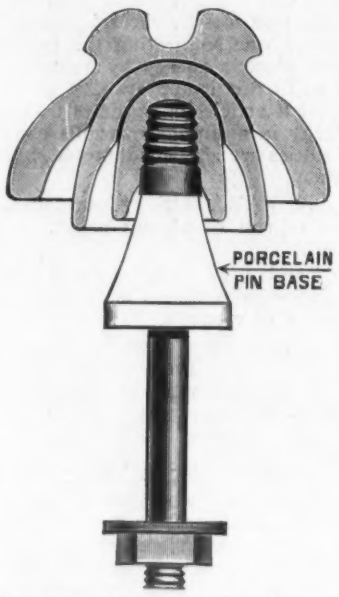
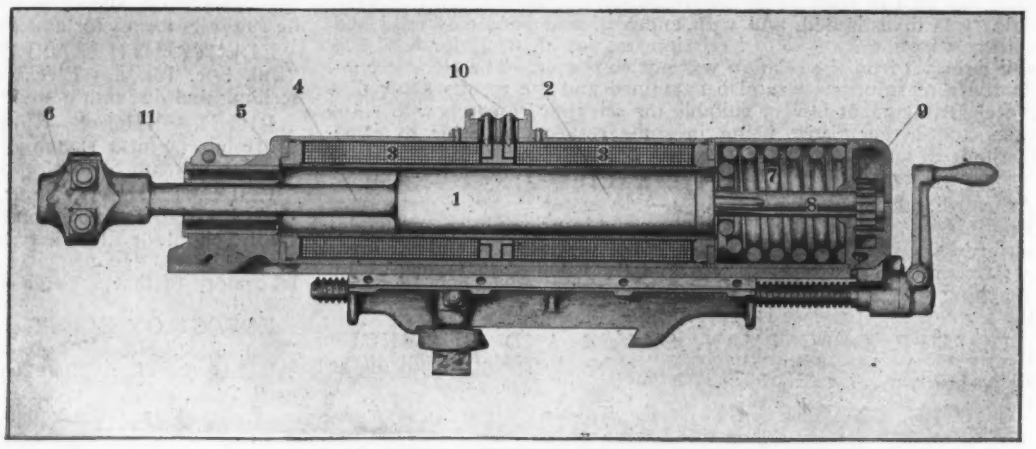


Diagram of Drill and Generator Circuits

Referring to the cut showing the section of the drill it will be observed that the body of the drill is composed of two coils (3-3) of wire, wound upon a tube, forming a double solenoid. The tube upon which the wire is wound is of steel, and brazed to steel heads at the ends. The coil is incased in a boiler tube, and the jacket hermetically sealed by calked joints at both ends. These coils alternately receive the half waves of an alternating current, thus imparting a

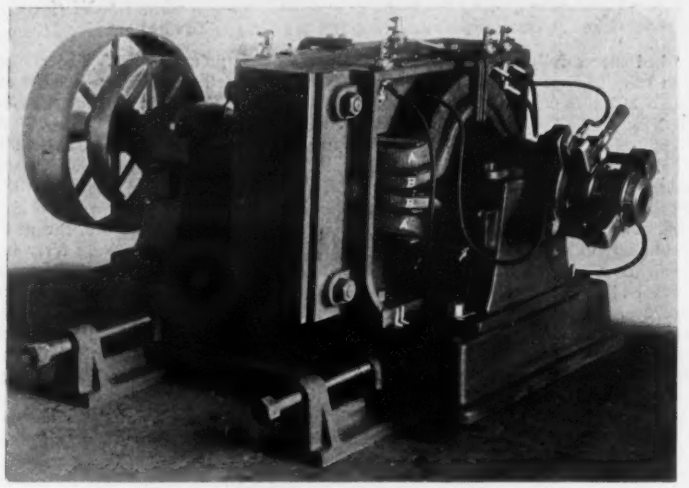


Built-up Porcelain Insulator.



Section of Electric Drill.

reciprocating motion to the plunger (1). The plunger is a soft steel forging with a chuck formed on one end to receive the bit. The helical spring (7) checks the back stroke of the plunger, returning the energy stored in the spring to the forward stroke. At the top of the plunger is a rifled bar (8) running in a rifled nut, which is provided with a ratchet wheel. Pawls engage

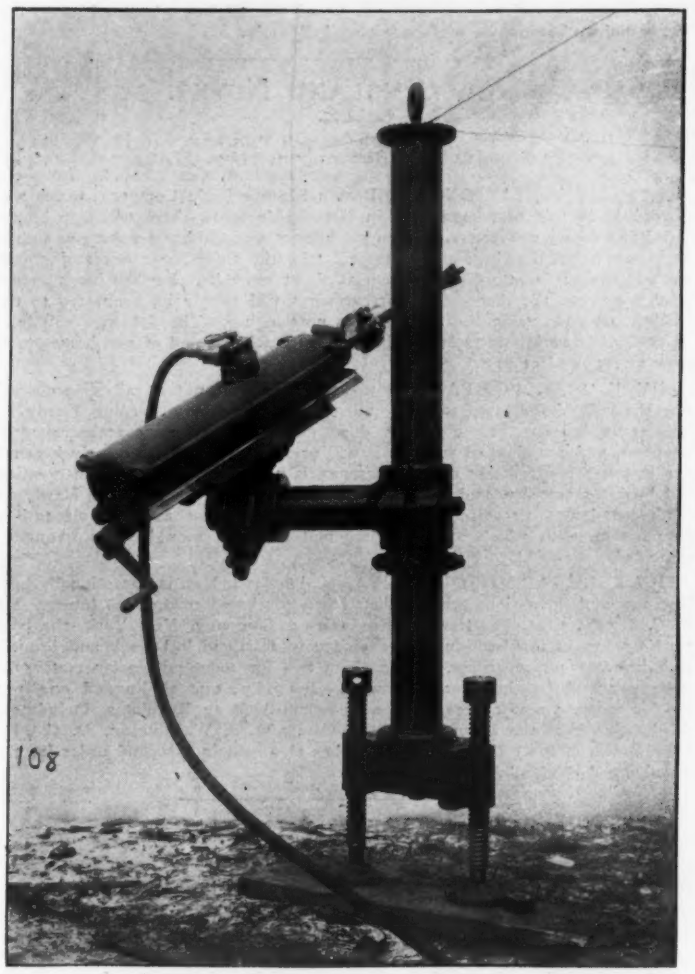


DRILL GENERATOR.

in the ratchet wheel, and prevent the rifled bar from turning backwards. This twists the plunger on the backward stroke.

The construction of the two solenoids (3-3) is of particular interest. They are made of square copper wire and insulated with mica placed between turns and layers. The absence of organic insulation makes the construction of these coils fireproof, and the square wire tightly wound and pressed into place prevents any disturbance of the insulation by the vibration of the machine.

One of the most noteworthy features of the drill is the entire absence on the drill of anything in the nature of a valve or switch, this being unnecessary as



6-INCH DRILL MOUNTED ON COLUMN.

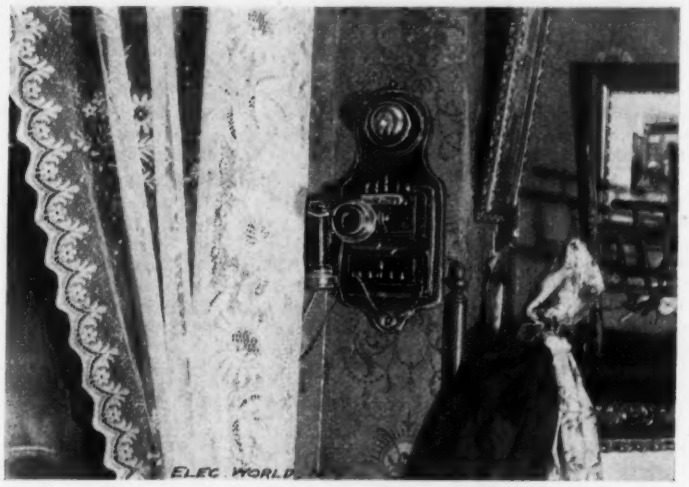
the current is directed alternately into the two coils by the generator itself. The generator is a two-pole machine, with a drum armature containing a loop winding, imbedded in slots, which are disposed over a portion of the periphery of the drum, filling opposite arcs. In this a single-phase alternating current is generated. One end of the loop winding terminates in a solid collector ring; the other terminates in a half ring, which alternately shifts the current into the two sides of the drill circuit by means of brushes resting upon the commutator at diametrically opposite points. No appreciable sparking results as the half ring leaves each brush at the instant when the alternating current is zero. Three wires are required to transmit the current to the drills. The diagramatic sketch shows the path of the current. As the flow of current in either of the outside wires is never reversed, the machine is easily compounded by interpolating a series coil in each outside wire, without the use of any further rectifying device. The middle wire, which is the common return for both phases of the current, receives an alternating current.

By referring to the generator diagram cut it will be observed that four coils are shown. Coils *B* and *B* receive current from a small exciter, as the machine is not self-exciting. Coils *A* and *A* are the compound coils receiving the current that passes through the drills, and maintain a uniform pressure of 135 volts at the drills, whether one or more are at work. The speed of the generator is usually 380 r. p. m., and every revolution of the armature produces one complete stroke of the drill.

The construction of the generator is unique, owing to the necessity for its transportation in small parcels to locations difficult of access. The field magnet is of rectangular shape, built up entirely of lamini, and into side channels in these lamini are laid the field coils, the ends of which are arched to avoid the shaft.

A Unique Telephone System for Residence.

One of the latest developments in independent telephony is the private telephone system especially adapted for residences, just put on the market by the Stromberg-Carlson Telephone Manufacturing Company, Chicago, Ill. The in-



WALL TELEPHONE FOR RESIDENCE.

struments may be used either as extension sets to public exchanges or in intercommunicating private plants.

Fig. 1 represents the wall telephone with plug switch for six-station intercommunicating system. This instrument is furnished with the company's regu-

COMBINATION SET IN THE PARLOR.

lar long distance transmitter, compound receiver and battery calling device of the highest grade. Fig. 2 represents a combination set sometimes used.

The instruments are both of handsome design, and are made of the best material obtainable, with the highest class of workmanship. They are an ornament as well as an instrument of great convenience.

News of the Week

Financial Intelligence.

THE ERIE TELEGRAPH & TELEPHONE COMPANY reports for the year ending December 31, 1897, gross earnings $364,550, an increase of $49,636. Expenses and interest $137,903, an increase of $31,629. Net earnings $226,647, an increase of $18,007.

THE EDISON ELECTRIC ILLUMINATING COMPANY, of New York, reports gross earnings for January, 1898, of $298,307.36, an increase of $56,008.31 over those of January, 1897; net earnings, $147,889.22, an increase of $23,345.72. These figures include the earnings of the high tension systems.

THE EDISON ELECTRIC ILLUMINATING COMPANY, of New York, has voted to increase its capital stock by 15 per cent., offering the additional amount to present stockholders at par. The new stock does not carry interest or dividends until fully paid. Payments will be required in three equal installments, namely, March 10, May 2 and August 2.

THE CITIZENS' ELECTRIC LIGHT & POWER COMPANY, of St. Louis, has filed an application for an increase of capital stock from $750,000 to $2,000,000. The company has not yet done any active business; it is one of the new concerns organized at the time the Keyes conduit bill went into effect. It built most of the subways embraced in the underground district.

THE METROPOLITAN STREET RAILWAY COMPANY, New York City, it is stated, will issue $10,000,000 additional stock, making the total stock issued $40,000,000. The proceeds will be used in retiring $6,000,000 scrip, which is outstanding, and leave in addition $4,000,000 to meet the cost of improvements and additions. It is stated that the new stock will be allotted at par to holders in the proportion of one share of new for every three shares of old stock held.

THE NEW ORLEANS TRACTION COMPANY has just issued its first annual report to its stockholders. The gross earnings for 1897 were $1,239,256, a decrease of $95,020, as compared with the previous year. The net earnings were $391,423, a decrease of $194,305. President Walmsley attributes the decreased earnings to the yellow fever in the fall and the increasing competition, but he is of the opinion that the worst is over, and that henceforth the properties will make a better showing. He does not think that any dividends will be possible for two or three years yet. At the end of 1896 there was a surplus of $68,448; at the end of 1897 the deficit was $80,741.

Special Correspondence.

New York Notes.

Office of THE ELECTRICAL WORLD,
253 Broadway, NEW YORK, Feb. 21, 1898.

SPRAGUE ELECTRIC COMPANY'S LOST PAPERS.—Some time between February 11 and 15 certain papers were abstracted from a desk in one of the rooms occupied by the Sprague Electric Company, in the Commercial Cable Building, 20 Broad Street, this city. The company has offered $1,000 reward for information which will lead to the arrest and conviction of the person or persons responsible for their disappearance.

A TELEGRAPHIC TOURNAMENT will be held in connection with the Electrical Exposition to be held at Madison Square Garden in this city next May. According to the announcement of this fact in "The Telegraph Age," one or more evenings in the month will be appointed on which the fast sending contest will be held, and there is a promise that the principal telegraphers of note will enter the lists. Mr. Fred Catlin, who managed all the previous important contests of this character, has been engaged by the Auxiliary and Educational Committee to conduct the one next May. Mr. Catlin's experience is a guarantee of the success of this enterprise. Mr. James D. Reid, well known among telegraphers as the "Father of the Telegraph," will act as chairman of the Board of Judges. Mr. Reid was United States Consul at Dunfermline, Scotland, and only recently returned to this country, after the expiration of his term of service. He is also an old telegrapher. Prizes will be awarded to the victorious contestants.

IT IS REPORTED that the Metropolitan Street Railway Company has closed a contract with the General Electric Company for the electric plant to go into the new power house of the railway company now being built at the foot of Ninety-sixth Street on the East River. The new power house will have a total capacity of 70,000 horse-power, and will furnish the power for the operation of every line owned by this company in the city, including the Broadway, Columbus and Lexington Avenue cable lines, which will eventually be changed over to the underground electric system. The equipment just contracted for will be of sufficient capacity to operate all the trolley roads of the company now built or under way. As other lines are made ready the power equipment will be enlarged to meet their needs. The equipment ordered, it is stated, will cost about $600,000, and will include 5000-hp generators. One of the most interesting features of the new plant will be the use of the three-phase high tension system for distribution purposes. Three-phase current will be sent out to sub-stations in various parts of the city and from there distributed to the different lines as direct current, using rotary transformers for the transformation from alternating to direct. The working pressure will be 500 volts.

THE TROLLEY SERVICE ON THE BROOKLYN BRIDGE has been largely increased during the past week. At the beginning of the week five Brooklyn lines began running their cars through to New York and everything worked successfully and smoothly from the operating point of view. The motormen soon became accustomed to their new work. Each car carried on its front dashboard a sign setting forth its destination. Some of the signs read: "Direct to New York," while others read, "Coney Island to Park Row" or "Fort Hamilton to Park Row." Through the rush hours the cars formed a procession, each car on a headway of about one minute. The schedule was closely adhered to without any trouble. The running time of the trolley cars across the bridge averaged about eight minutes, against six minutes by the regular bridge cars. In the evening a greater number of cars were put into service, the number being sufficient to run them out of the New York terminus every forty-five seconds. Eight extra bridge policemen have been assigned to duty at the New York end to see that pedestrians are taken care of in crossing the tracks, and that everything runs smoothly. Later in the week the cars of two other lines were put on the bridge service. The automatic electric counter, which records the number of cars passing onto the bridge, showed that during the twenty-four hours Wednesday 1377 cars crossed to New York. The bridge gets a toll of 5 cents per car, thus bringing the receipts from this source on Wednesday up to $68.85. The receipts of the bridge fell off on the same day $380 from what they had averaged, and as the income had been running ahead of the average about $200 a day recently, the real difference which the free bridge rides on the trolley cars seems to have made is $580 for the day. These figures indicate that the trolley cars carried on Wednesday 14,500 passengers who would otherwise have taken the bridge trains. As a matter of fact, however, they carried a great many more, for the number who walked across the bridge was noticeably smaller. Some mechanical improvements suggested by the experience of the few days' actual service have been made on the overhead trolley, structure. It was noticed that there was a tendency on the short curves at the New York loops for the trolleys to leave the wire. This, however, has been remedied by the adoption of a trough, which has been erected over each trolley wire at the curves. The troughs are electrically connected with the trolley wire so that in case the trolley does leave the wire the cars are not stalled, but continue to receive their power. A new system of lighting the bridge entrance in the immediate vicinity of the trolley loops has been inaugurated. Around each column is a circle of ten 32-cp lamps, and outside of these are bunches of five lamps of the same size. There are 300 of these lights, which, added to the old arc lights, illuminates the space very brilliantly.

New England Notes.

Branch Office of THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, Mass., Feb. 19, 1898.

IN THE NEW STATION of the Boston Electric Light Company, which was referred to in this correspondence in last week's issue, there will also be installed two rotary converters, each of 500 kilowatts or 650 horse-power, to supply the power circuits. These machines will take the three-phase alternating current and convert it into direct current at about 550 volts. For the incandescent lighting system, the three-phase current wires will simply be connected to the existing network, using the transformers now in use. The dynamos will have a capacity of 1500 kilowatts or 2000 horse-power each, instead of 3000 horse-power each, as reported at first.

THE K. & W. COMPANY, Pittsfield, Mass., is not at all disconcerted over the suit of the lamp trust for alleged infringements regarding Hardy incandescent lamps. The company does not apprehend any embarrassment whatever, and confident of success, it will press the matter to an early hearing. The business management of this company is noted for exceeding conservatism and business sagacity, and before entering into the manufacture of Hardy incandescent lamps it received the advice of eminent counsel as to the strength of its position, with which opinion competent practical men have subsequently coincided.

THE BELKNAP MOTOR COMPANY, Portland, Me., is exceptionally busy just now and indications are excellent for a continued prosperous future. Mr. F. C. Brewster, of the Brewster Engineering Company, New York, the company's agent in that section, was a visitor in Portland last week and brought with him some nice orders, among them two for 10-hp multipolar motors for passenger and freight elevator service, one 20-hp, one 7½-hp and one 5-hp bipolar motors; also orders for the Chapman Voltage Regulator, including a third order from the Potomac Electric Company, of Washington, D. C. The New Haven (Conn.) Electric Company has also sent in a second order for this popular and efficient voltage regulator.

Philadelphia Note.

Branch Office of THE ELECTRICAL WORLD,
929 Chestnut Street,
PHILADELPHIA, Pa., Feb. 19, 1898.

THE ANNOUNCEMENT is made that a controlling interest in the stock of all the independent electric light companies of Philadelphia has been acquired by the Pennsylvania Manufacturing, Light & Power Company, incorporated under the laws of New Jersey, with a capital stock of $15,000,000. The new company will issue $15,000,000 collateral 5 per cent. gold bonds in exchange for the stock of the minor companies. The organization of the new company has not yet been effected, but Mr. Martin Maloney will be made president when it is completed. The companies remaining outside of the combine are the Southern, the Kensington and the West End.

BUFFALO AND NIAGARA FALLS NOTES.

BUFFALO, N. Y., Feb. 19, 1898.

THE BUFFALO GENERAL ELECTRIC COMPANY has settled on the disused Wilkeson Street station as its future lighting headquarters for the city and plans for the necessary alterations are under way. The buildings will not have to be changed very extensively.

THE LOCKPORT POWER COMPANY has been awarded by the Common Council of that city the contract it asked. Some time ago this company agreed to build a power and water supply canal from Niagara River to Lockport if the city would pay it $50,000 a year for water for ten years. The plan is to develop large water power for the generation of electrical energy by utilizing the cliffs, the summit of which is well below the level of Niagara River.

TWO NEW TELEPHONE COMPANIES have asked for franchises this week. The first application was by the Buffalo Telephone Company, as yet known mainly through its attorney, W. B. Hoyt, it not having been incorporated. No mention is made of anything but Buffalo capital in it, and it is claimed that there is enough of that to make the company very strong. It is also said that many of the stockholders stand very close to the leading members of the Board of Aldermen, to which the application was made. The second application was made by the Western New York Telephone Company, which has been incorporated with a capital of $500,000. The stockholders are local politicians, with whom the companies appear to have taken care to make themselves very solid, so that there is a good chance of at least one company obtaining the franchise, though a cut of rates will no doubt have to be promised at the outset.

THE RECENT NEGOTIATIONS opened with the Canadian authorities and manufacturers by Secretary Rankin of the Tunnel Company are said to be in the interest of an early development of power on the Canadian side of the falls. It is held that the company will not develop its plant on this side further than to set up the present lot of seven generators, which will give the plant a total capacity of 50,000 horse-power, for the necessary outlay on the Canadian side will be so comparatively slight that the original plant would have been built there, but for the necessity of propitiating the American capitalists and manufacturers, who will be the chief customers of the company. The tunnel required will not need to be but a few rods long, and $500,000 will do what has taken $3,500,000 to do on this side. So the plan appears to be to set up the Canadian plant in time to save the franchise, and connect the two so that they can be run on a belt line and supplement each other.

PITTSBURG NOTE.

PITTSBURG, Pa., Feb. 19, 1898.

IT IS REPORTED that the Allegheny County Light Company will extend its system of electric lighting in the county by establishing a number of substations in which gas engines will be used to drive the generators. The large supply of natural gas with which gas engines can be driven increases the feasibility of the plan, and the Allegheny County Light Company will in the near future, if the proposed sub stations are established, have one of the most extensive plants in the country.

CHICAGO NOTES.

Branch Office of THE ELECTRICAL WORLD,
936 Monadnock Building,
CHICAGO, Ill., Feb. 18, 1898.

THE REPORT that Prof. Elisha Gray, of Highland Park, Ill., was dangerously ill turns out to be unfounded. Professor Gray informs his friends that there was some mistake, as he is enjoying good health and not in any danger of dying as far as he can judge.

REPRESENTATIVES OF THE ILLINOIS TELEPHONE ASSOCIATION propose to make war on the McGinnis bill now before the Legislature for taxing all telephones $2 each and slot telephones $50 each. The telephone manufacturers of this city also propose to wage warfare against the same bill, claiming that the measure will work great harm to the independent telephone business if passed. It is stated that the measure will not hurt the Bell Company as much as the independent companies, for the reason that the older corporation feels itself well intrenched by the occupancy of the field in the larger cities.

ST. LOUIS NOTES.

ST. LOUIS, Mo., Feb. 18, 1898.

THE CITIZENS RAILROAD is having thirty-three new cars constructed with detachable vestibules. They will be elaborately equipped with all modern improvements and will cost $3000 each. The company is getting ready to equip its Broadway line with electricity, beginning about May 1.

HAND TELEPHONE AS AN AID TO THE FIRE DEPARTMENT.—George W. Warrance, superintendent of the Missouri Electric Light & Power Company, has about completed a hand telephone to be used by the fire department, in cases of great emergency, at large fires where orders from the chief, assistant chiefs or foreman are to be transmitted to the men. Mr. Warrance is an expert electrician, and his invention will be of great benefit.

COLORADO NOTES.

DENVER, Col., Feb. 11, 1898.

THE TOWN BOARD, of Sterling, Colo., has adopted a resolution providing that a proposition for bonding the town for $12,000 to install water works and an electric light system be voted upon at the April election.

POWER PLANT NEAR LAKE CITY.—A project is under consideration for constructing a large electric power plant at Lake City. It is proposed to dam the waters of Lake San Christoval and utilize the water power in generating electricity for distribution to the surrounding mines. At present the cost of developing power at the mines is extremely high, owing to the expense incurred in hauling coal up the steep roads of the district. It is said that a three-phase plant will be installed and that the farthest point to which current will be carried will be about 12 miles. It is asserted that Standard Oil officials are behind the project.

NEW COMPANIES.—The Needle Mountain Electric & Power Company, with a capital stock of $200,000, has been incorporated at Durango, Colo., by L. B. Jordan, John Larsen and George F. Caine. Articles of incorporation of the Colorado Messenger & Signal Company have been filed at Colorado Springs. The incorporators are M. A. Leddy, Frank W. Howbert and Belvidere Brooks. The company proposes to build electric lines for the transmission of signals, to maintain a telegraph system and to sell electrical machinery. The capital stock is $60,000. The directors of the company for the first year are: M. A. Leddy, Belvidere Brooks, Frank W. Howbert, John J. Dickey, I. N. Stevens, John A. Voorhees and R. C. Clowry. Mr. Dickey is the Western Superintendent of the Western Union, with headquarters at Omaha, and Mr. Clowry, of Chicago, is vice-president of the Western Union.

COLORADO SPRINGS-CRIPPLE CREEK ELECTRIC COMPANY.—It has been announced that funds for the construction of the electric road from Colorado Springs to Cripple Creek have been secured and that the line will be built. The manager of the railway is L. D. Ross, of Colorado Springs. The railway will enter the mountains from Colorado Springs by the Bear Creek Canon, and will ascend to the top of the range by easy gradients and thence by an easy grade down the slope to the Cripple Creek district. The route has been surveyed, and it is said there is abundant water power along the line to furnish power at the generating stations, of which there will be two—one on the eastern division and one on the western division. According to the existing plans a three-phase electrical system will be installed. It is said that several prominent mining men of Cripple Creek are interested in the plan, and that they propose to build a smelter at Colorado City for the treatment of their ores as well as the railway to transport them.

DENVER-CRIPPLE CREEK ELECTRIC ROAD.—The project of connecting the Cripple Creek district with the capital of the State has been recently revived. Judge J. E. Rockwell, of Denver, is authority for the statement that an effort is making to secure the necessary capital for the enterprise. According to him the road will start from Cripple Creek and will thence be laid to a point between Florissan and Lake George, avoiding the Midland Terminal Railway which runs to the town of Divide. Thence the road is to be built down the canon of the south fork of the South Platte to the town of South Platte, following the grade laid out several years ago by the Denver & Rio Grande Railway as a short line to Leadville. The distance to the entrance of the canon, 9 miles, is the one difficult stretch as a new grade must be established and the canon must be crossed several times, necessitating a corresponding number of bridges. It is thought by Judge Rockwell that the construction of the road will be commenced next summer if the funds are raised. It is stated that the projectors will use the water power of the Platte for the operation of the railway. It is also announced that if the road is built power for mining plants along the route will be furnished. It is estimated that the cost of equipping the railway would be $1,500,000.

TEXAS NOTES.

SAN ANTONIO, Texas, Feb. 13, 1898.

THE GULF COAST TELEPHONE COMPANY has begun the construction of its line from Goliad, Tex., to Refugio.

THE SOUTHWESTERN TELEPHONE & TELEGRAPH COMPANY has been ordered by the City Council of San Antonio, Tex., to resume the work of placing its wires in this city underground.

THE WINSBORO ELECTRIC LIGHT & POWER COMPANY has just been organized for the purpose of establishing an electric lighting and power plant at Winsboro, Wood County, Texas. The incorporators are R. G. Andrews, C. H. Morris, W. T. Whitman and Manton W. Jones, all prominent citizens of Winsboro.

THE SAN ANGELO ICE & POWER COMPANY has been organized at San Angelo, Tex., the object of the company being to manufacture and supply electric light, heat and motor power, and to manufacture and sell ice and provide cold storage. The capital stock of the company is $30,000, and the incorporators are George Bond, George E. Webb, C. H. Powell and others.

MEXICAN NOTES.

MONTEREY, Mexico, Feb. 13, 1898.

THE SIEMENS & HALSKE COMPANY, which has the contract for lighting the City of Mexico by electricity, has completed the installation of its plant, and has made several very satisfactory tests of the lights. Its contract will go into effect on February 15.

IN THE CITY OF CAMPECHE, Mexico, the subscribers would not accept the telephones which the Compania Telefonica Mexicana put in. There were about forty subscribers at $5 per month. The instruments were taken out, and Senor Eduardo Massa bought the poles and wires for use of another company which proposes to give satisfaction.

MR. WALTER T. PECK, one of the best known and most popular electrical men in Mexico, has returned to his old home in Schenectady, N. Y., after a residence of a few years in this country. Mr. Peck made his headquarters in the City of Mexico, where he held a high position with the General Electric Company. Prior to his departure from this country he was given a banquet by a number of his friends at the American Club in the City of Mexico. The dinner was a very pretty affair. The table was tastily decorated, and covers were laid

for forty-three guests. President W. O. Staples, of the American Club, officiated as toastmaster, and some very complimentary things were said of the parting guest.

THE ELECTRIC LIGHT PLANT at Tampico, Mexico, which was owned by Don Panclo Perez, has just been purchased by a company of Americans composed of Messrs. J. J. Hoag, W. E. Bault and J. E. Hoag, all of Manchester, Ia. The name of the new company is the Electric Light & Power Company of Tampico. The price which these gentlemen paid for the plant was $22,000, Mexican money. The capacity of the plant is to be immediately doubled, and an incandescent system will be added. The improvements in the way of the new machinery and new buildings will cost about $30,000. Tampico is one of the most prosperous and growing gulf ports in Mexico. It is a city of about 18,000 population.

Pacific Coast Notes.

San Francisco, Cal., Feb. 12, 1898.

THE SUBJECT of an electric railroad from San Jose, Cal., to Los Gatos is being agitated.

MR. HENRY A. BUTTERS will leave in a few days for the City of Mexico, where he will have the management of the street railway lines which were acquired by the company that he represents.

NEWSPAPER REPORTS have it that capital has been obtained, and that preliminary engineering work will soon be commenced upon a long distance transmission line that will ultimately reach San Francisco. The electric power is to be supplied by the Blue Lakes Water Company's plant; distance, 140 miles.

French Notes.

(From Our Own Correspondent.)

Paris, Feb. 3, 1898.

THE GROWTH OF PARIS.—The Chamber of Deputies has just unanimously voted to destroy the fortifications to the west and southwest of Paris. This great project, which will probably be put into immediate execution, has been discussed for a long time, but nobody thought it would be so quickly and so completely accepted by the Deputies. Hereafter, starting from Point du Jour, the Seine will serve as the boundary of Paris so that Billancourt, Boulogne, the Bois du Boulogne, Neuilly, Levallois-Perret, etc., will be included in the city. It is to be hoped that the other half of the fortifications will also soon disappear. Their removal makes a great change in many respects. In addition to their absolute uselessness, demonstrated elsewhere since the war of 1870, the fortifications interposed an insuperable obstacle to the extension of communicate facilities, and especially to mechanical traction. Practically all stopped at the surrounding wall, despite the great openings in them, which seldom or never coincided with the town gates. From this state of things it followed that the tramways found difficulty in connecting the suburbs with the central part of the city. It will no longer be so, however, in the whole region lying to the west of Paris. Hereafter the way will be free and, at last, some of the numerous plans for electric railway lines, so long discussed, can be put into execution.

ELECTRIC LIGHTING OF RAILWAY CARS.—The Compagnie des Chemins de Fer du Nord, which made the first experiments in electric train lighting in 1885, has just definitely adopted it. For a long time this question has occupied the attention of railway companies and many of them have been seeking for a practical method of installation. The need for a better illumination of cars has become more and more pronounced, and nowadays the passenger, whether bound on a long or a short journey, wishes to read or occupy himself with other affairs requiring that his compartment be properly lighted. Good lighting also gives a traveler a more contented feeling. Now, after trials of various oil and "perfected" petroleum lamps, electric lighting is to have a trial on French railways. The advantages of electric lighting for trains are too well known to require repetition here . Incandescent lamps alone can give the powerful and absolutely steady light required. All the difficulties of ventilation, of lighting and extinguishing, and of maintenance disappear when the electric light is used. The dangers of fire and explosion are eliminated. By the use of accumulators on each car complete independence of the cars is attained. These various advantages, as enunciated in a note by M. Sartaux, electrical engineer for the Compagnie du Nord, have been fully appreciated by the administration of the French post office, a large number of postal cars electrically lighted having been put in service on the northern railways. In these cars good light is a prime necessity. The battery of accumulators consist of sixteen elements arranged two by two in willow baskets. Each element consists of a jar of insulating material large enough to hold from seven to thirteen plates, each 100 by 200 millimetres (4 by 8 inches). The negative plates are 6 and the positive plates are 7 millimetres thick. Their working capacity is ten ampere hours per kilogramme of plates. The accumulators are placed in four boxes hung from the sills of the car, two on each side. The lamp fixtures consist of a zinc hood carrying a reflector of white enameled sheet iron and a socket. Upon the hood is fixed a handle for raising or lowering it. The lamps used are of six to ten candle-power, and work at twenty-five volts. For lighting baggage cars the accumulators are placed in the car in special boxes, while for pay cars and other office cars they are placed as in the postal cars. Charging the batteries is done without their removal from the train by means of conductors installed alongside the tracks at the termini. The experiments of the Compagnie du Nord have shown the most excellent and satisfactory results from all points of view.

REORGANIZATION OF THE MILITARY TELEGRAPH CORPS.—The Ministers of War and Commerce have presented the following project concerning this subject: "Article 1: The military telegraph service comprises in time of war (1) active telegraph troops, and (2) technical telegraph officers. In addition to this the personnel of the administration of posts and telegraphs in the zone of operations is put under the orders of the commander-in-chief of each army division or of each army operating independently. Article 2: The Minister of War undertakes with the resources at his command the telegraph service of the first line of defenses and that of fortified places, detached forts and military posts. The active telegraph troops are intended to insure the service of the first line. They are composed of companies of telegraph operators, and, on occasion, of detachments of various arms for special service. Article3: The technical telegraph officers will look after the second line of defenses. These technical officers are all officers, agents or sub-agents of the administration of posts and telegraphs, either volunteers or those obligated on account of their age to military service. Their organization will be governed by rules jointly formulated, after consultation, by the Ministers of War and Commerce. All persons called upon to take part in this service will be instructed at the rendezvous in time of peace. The necessary expenses of the technical corps, both as to personnel and material, will be borne upon the budget of the Ministry of Commerce. Article 4: A battalion of telegraphers is organized and attached to the Fifth Regiment of Engineers. The personnel of this battalion of operators (officers and privates from the reserve of the regular army) will be drawn from the reservists belonging to the regiment, or, in case of the insufficiency of these resources, will be furnished from the personnel of the administration of posts and telegraphs, within limits and under conditions to be prescribed by the Ministries of War and Commerce. Article 5: A high commission of telegraphy is organized in connection with the Ministry of War. It is charged with the giving of advice upon all questions connected with the employment of telegraphy for army purposes. This commission will comprise representatives from the different ministerial departments interested, and its members will be nominated by decree. Article 6: The decree will determine (1) the composition and the duties of the chief military telegraph commission, and (2) the organization of the telegraph service in case of war." From a table annexed to the statement of the projected reorganization, the effective strength of the battalions of six companies is shown to be, in time of peace: (1) General staff; one lieutenant-colonel or chief of battalion, commanding; one captain (adjutant-major); (2) secondary staff; one adjutant, a scout, six soldier mechanics or electricians and two secretaries; (3) company formation; one captain, two lieutenants, one adjutant, one sergeant-major, eight sergeants, one quartermaster-sergeant, sixteen corporals, one scout and seventy-two privates, a total of twenty officers and 628 men.

General News.

New Incorporations.

THE NATIONAL MILL, WATER & LIGHT COMPANY, Angola, Ind., has been incorporated with a capital stock of $100,000.

THE VERSAILLES TELEPHONE COMPANY, Versailles, Ky., has been incorporated by W. R. Proctor, B. B. Smith and Charles R. Powell.

THE LIGHT & POWER COMPANY, Trenton, Mo., has been incorporated with a capital stock of $30,000. The incorporators are C. O. Hoffman, E. M. Hartar, W. O. Garvin and others.

THE STANDARD ELECTRIC LIGHT, HEAT & POWER COMPANY, Avoca, Pa., has been incorporated by Mr. Jordan, of Tunkhannock, president; John M. German, of Wilkesbarre, secretary.

THE OGLE COUNTY TELEPHONE COMPANY has been incorporated at Rochelle, Ill., with a capital stock of $5000. Among those interested are F. W. Hamlin, John Delancy and A. W. Guest.

THE LIVINGSTON COUNTY TELEPHONE COMPANY has been formed at Pontiac, Ill., with a capital stock of $65,000. The incorporators are W. E. E. Herron, John S. Murphy and A. M. Legg.

THE TELEPHONE CONSTRUCTION COMPANY has been incorporated at Trenton, N. J., by George W. Wentz, Spencer Weart and William L. Rees. The principal place of business of the new company will be Jersey City.

THE PORT JEFFERSON ELECTRIC LIGHT COMPANY, Port Jefferson, L. I., N. Y., has been incorporated by John V. N. Bergen, president; Charles P. Randall, vice-president; W. T. Wheeler, secretary and treasurer.

THE MANKATO CITIZENS TELEPHONE COMPANY, Mankato, Minn., has been organized with the following officers: President, Lorin Cray; vice-president, Fred Kronisi; secretary and treasurer, John B. Meagher. The capital stock of the new company is $25,000.

THE ROBB CONDUIT & UNDERGROUND ELECTRIC SYSTEMS COMPANY, New York, has been incorporated with a capital stock of $25,000. The directors are Fred. D. Robb and George E. Crittenden, Hot Springs, Ark.; A. L. Weir, of New York, and others.

THE FULTON COUNTY TELEPHONE COMPANY, Fulton, N. Y., has been formed with a capital stock of $15,000. The directors of the new company are Lenox Smith and J. P. Whitaker, New York City; George C. Webb, J. C. Curtis, Francis Stiles and F. A. Sage, Fulton.

THE IRWIN & McKEESPORT ELECTRIC RAILWAY COMPANY, Irwin, Pa., has been incorporated with a capital stock of $120,000. The incorporators are John George, president; C. R. Fritchman, secretary-treasurer. The length of the proposed electric road will be 6½ miles.

THE CHICAGO CITY TRANSIT RAILWAY COMPANY, Chicago, Ill., has been incorporated with a capital stock of $1,000,000. The incorporators and directors are Frank R. Greene, John F. Johnson, Charles L. Compton, William J. Bartram, John Fitzpatrick, Henry Brown and J. L. Turner.

THE BUCKSPORT & EAST ORLAND TELEPHONE COMPANY has been incorporated at Bucksport, Me., for the purpose of leasing a line of telephone from Bangor to Bucksport. The officers of the company are: President, J. B. Brainerd, of Orland; treasurer, John N. Swasey, of Bucksport. The capital stock of the new company is $2,000.

THE WESTERN NEW YORK TELEPHONE COMPANY, Buffalo, N. Y., has been incorporated with a capital stock of $500,000, for the purpose of operating a telephone line in Buffalo and in the cities and villages of the counties of Erie, Niagara, Orleans, Genesee, Cattaragus and Chautauqua. The directors and stockholders are Edward Mitchell, Henry Koons, Alonzo R. James, Tracey C. Becker, L. F. Messer, Isadore Michael and W. S. Grattan, all of Buffalo, and R. F. Rankine and S. J. Lawrence, of Niagara Falls.

THE TELEGRAPH AND TELEPHONE.

GETTYSBURG, PA.—The telephone company has decided to build a line to Bonneauville and Hunterstown.

DOVER, DEL.—It is stated that the Diamond State Telephone Company will extend its lines to Lewes and Milton.

TOPEKA, KAN.—A dividend of 4 per cent. was declared on February 1 by the Missouri & Kansas Telephone Company.

ONEIDA, N. Y.—The Common Council has granted a franchise to the recently incorporated United Telephone Company.

AKRON, OHIO.—An attempt will be made to sell the telephone franchise in Akron to the highest bidder. The Central Union Telephone Company's franchise expires in September.

DETROIT, MICH.—The new State Telephone Company will build an exchange in Owosso and will extend its service to Trenton from that town. It is expected that the new exchange and toll lines will soon be in operation.

MADISON, WIS.—The annual report of the Wisconsin Telephone Company for the year 1897 shows gross receipts of $434,768.74, making the State tax of 3 per cent. $13,043.06. The company has in use 17,803 miles of wire and 10,027 instruments.

CENTERVILLE, IA.—The City Council has granted a franchise to the Northwestern Telephone Supply Company, which will now complete its organization and establish a telephone exchange with long-distance connections. The rates for business houses will be $1.50 per month and for residences $1.00 per month.

LISBON, OHIO.—The Carroll County Telephone Company has been granted a franchise by the County Commissioners, and will construct lines to all the towns in the county. An exchange will be established at Carrollton. It is expected to have the line in operation by May. The circuits will be extended to connect with Steubenville and Canton.

THREE RIVERS, MICH.—The Central Michigan Telephone Company, of Kalamazoo, expects to reach the Three Rivers exchange in a few days. The State system is one of the best ever built, being entirely of copper wire, and the first line carried into the city will include six wires and will connect this place with twenty towns immediately, including Kalamazoo and Grand Rapids.

GRAND RAPIDS, MICH.—Through its line to Kalamazoo the Citizens Telephone Company will have a complete line to Fort Wayne and Portland, Ind., within thirty days. The Kalamazoo people have already begun their line to Sturgis and Fort Wayne. The Fort Wayne end is extending a copper metallic circuit to Toledo and will eventually reach out through Southern Indiana.

INDIANAPOLIS, IND.—A telephone war has broken out in this city. The Central Union Telephone Company has been suddenly confronted by two other companies—the New Telephone Company and the Citizens Co-operative Telephone Company. The New Telephone Company has asked for a franchise. It is stated that within ten days it has secured 2000 contracts, nearly all subscribers of the old company.

CANTON, OHIO.—The Carroll County Telephone Company, which was recently granted a franchise over the highways of Stark County, is said by one of the projectors to be one of the many component parts of the gigantic system extending its lines and exchanges all over the United States and Canada. The independent lines in this State already extend out from Pittsburg, Wheeling, Steubenville and Columbus.

DETROIT, MICH.—The Detroit Telephone Company has offered for sale at par $100,000 worth of twenty-five year gold bonds bearing interest at 6 per cent. Preference is given to Detroit capital. The mortgage on the franchise, conduits and apparatus of the Detroit Company, which secures the bonds, authorizes the sale of $600,000 worth of bonds on a plant of 5000 telephones. The Central Trust Company, of New York, is the trustee.

ELECTRIC LIGHT AND POWER.

SYCAMORE, OHIO.—The citizens have voted to issue $20,000 in bonds for water and electric lights.

MAPLETON, MINN.—Delawan, Minn., is to have an electric light plant. A company is organizing.

RANDOM LAKE, WIS.—A company has been formed to construct an electric lighting plant at Elkhart Lake.

ASPINWALL, PA.—The contract for building an electric light plant has been awarded by the town council at $4000.

PITTSBURG, PA.—The Morgantown, W. Va., City Council has voted to spend $10,000 to build an electric lighting plant.

HACKENSACK, N. J.—The Hackensack Electric Light Company will enlarge its Hudson Street plant in the near future.

MANSFIELD, OHIO.—Sycamore, a town in Wyandot County, has voted to build an electric light and water works plant out of a $20,000 bond issue.

ANNAPOLIS, MD.—A bill has been introduced in the Legislature to authorize Takoma Park to construct an electric light plant and to issue bonds for the same.

OAKLAND, MD.—The Legislature will be asked to give authority to Oakland to issue $55,000 in bonds for water works, street improvements and a municipal lighting plant.

WASHINGTON, D. C.—The Catonsville (Md.) Ice, Light & Power Company has purchased the franchise and good will of the Ellicott City Light & Power Company for $2000.

PENN YAN, N. Y.—Mr. Calvin Russell has been elected president of the Penn Yan Electric Light & Power Company; Mr. C. T. Birkett, vice-president and treasurer; and W. Stanley Bruen, secretary.

SUFFOLK, VA.—The bill authorizing the town to borrow $25,000 for the construction of an electric lighting plant passed the Legislature last week. Work on the plant will be commenced in the near future.

CHARLESTON, S. C.—At the annual meeting of the Charleston Thomson-Houston Electric Company, Mr. A. M. Searles was elected president; George Sefton, vice-president; and F. A. Brooks, secretary and treasurer.

CHICOPEE, MASS.—This place has had a year of municipal electric lighting and is short $7885. It is likely that the State commission will require the city to raise the price of lights to place the enterprise on a paying basis.

NEW YORK, N. Y.—Two good contracts for lighting plants for export were placed last week, one for Italy and another for France—the latter probably for reshipment to some place in South America. Both aggregated $34,000.

GRAFTON, VA.—The Town Council of Grafton has contracted with the Fort Wayne Electric Corporation for the erection of an electric light plant in this city, with a capacity of 100 arc lights. The plant will cost $8600, and is to be completed by April 1 next.

VINELAND, N. J.—Articles of incorporation have been filed at Trenton of a company entitled "The Maurice River & Electric Power Improvement Company of Vineland." The object of the company is to generate electric power for manufacturing and other purposes in Vineland.

RICHMOND, IND.—The Richmond, Light, Heat & Power Company is not desirous of furnishing electric lights. Gas is more profitable, and the company controls both plants. A plan is now proposed for the city to build its own electric light plant, and the city council has taken the matter up.

PATERSON, N. J.—The annual meeting of the stockholders of the Edison Electric Illuminating Company was held a few days ago and directors were elected. The directors elected the following named gentlemen as officers for the ensuing year: President, William T. Ryle; treasurer, Arthur Ryle; secretary and manager, William M. Brock.

MONTREAL, CAN.—Mr. Albert J. Corriveau, of this city, and others are making application to the Dominion Parliament for an act incorporating the Montreal & Lake Champlain Canal Company. The scheme is one of considerable magnitude and will be of international importance. Mr. Corriveau states that electricity will be wholly employed for towing purposes through the canal, as well as at the locks.

ELDORA, COL.—Surveying for the new electric power and light plant at Eldora is to begin immediately. The water is to be piped to the plant, and in a short distance a fall of 600 feet can be obtained. It is expected to develop 500 horse-power at the start. This will enable furnishing not only an abundance of light to the town, but much power to the mines. It was reported in Port Boulder that W. S. Stratton, of Colorado Springs, has purchased $75,000 worth of mining property near the town, and the power to be furnished will come from the electric company.

THE ELECTRIC RAILWAY.

NAPLES, N. Y.—An electric road will be built this summer from Clyde to Lake Ontario.

FITCHBURG, MASS.—The Board of Alderman has voted in favor of granting a franchise to the Fitchburg & Leominster Street Railway Company.

ROCHESTER, N. Y.—It is reported that the Erie Railroad between Buffalo, Tonawanda and Lockport is to be equipped with trolley wires this year.

BOSTON, MASS.—The Consolidated Street Railway Company, Worcester, will put in a new 1200-hp engine, expecting a big increase in summer business.

MILWAUKEE, WIS.—The Milwaukee Council has rejected the application of the Citizens Traction Company, for an ordinance permitting the construction of certain city lines.

PASSAIC, N. J.—The Bergen County Traction Company is anxious to cross the Erie tracks at Englewood in order to continue to Hackensack. The question is before the courts.

SYRACUSE, N. Y.—The Baldwinsville village trustees have refused to grant a franchise to the Onondaga Lake Railway Company, which desired to operate an electric railway between Syracuse and that town.

LA PORTE, IND.—Judge Biddle has appointed L. L. Spiro, of Michigan City, receiver for the Lake Cities Electric Company, operating a street railway and a lighting plant in that city. The concern is involved to the extent of $30,000.

NORTH TONAWANDA, N. Y.—After several years unsuccessful contention, the New York Central Railroad has allowed the Buffalo, Tonawanda & Niagara Falls Electric Railway to cross its tracks at Sweeney and Webster streets.

ROCHESTER, N. Y.—The proposed trolley road from Penn Yan to Lyons, via Geneva, is uncertain yet. Baltimore parties representing $400,000 are said to be behind the project. If built at all the road will be exclusively for passengers.

BOSTON, MASS.—The Newtonville & Watertown Street Railway Company has petitioned the Boston Railroad Commissioners to enter the city, promising a 5-cent fare from Allston to all the Newtons, and possibly to Waltham, Watertown and Needham.

NEW YORK CITY.—President Vreeland, of the Metropolitan Street Railway Company, has contracted with the J. G. Brill Company, Philadelphia, for 500 electric cars of the most improved construction, most of them to be delivered early in April. The cost will be nearly $900,000.

CHESTER, PA.—Messrs. E. W. Clark & Co., the Philadelphia bankers, have bought the Dyer Estate's holding of the Chester Traction Company. The purchasers are at the head of the Scranton system, and have acquired the Wilmington, Del., trolley roads. The Wilmington, Chester and Philadelphia system will all be connected.

PHILADELPHIA, PA.—The Lehigh Valley Railroad will soon withdraw many of its local trains on the Northwestern New York lines, the coal branches,

the line between Mauch Chunk and Easton, and the Easton and Amboy division. It is done to save useless expense in competing with the trolley lines, which get most of the local passenger business.

EASTON, PA.—The South Bethlehem & Hellertown Electric Railway Company has voted to immediately extend the line from Northampton Heights to Freemansburg.

BALTIMORE, MD.—A bill has been introduced in the Maryland Legislature to prevent further consolidation of street railways in Baltimore, and to fix the fare at 5 cents for persons over twelve years of age and 2 cents for those between four and twelve. The bill also requires that the roads shall interchange transfers at intersecting points.

ASBURY PARK, N. J.—A company has been at work here for a week securing consents for a trolley road from Atlantic Highlands to Asbury Park. Nearly all the options necessary were obtained. The new road will be 15 miles long. Fast steamboats are to connect at Atlantic Highlands for New York. The construction of the road will be commenced in the spring.

Legal Note.

CEMENT-LINED PIPE PATENTS SUSTAINED.—In the Circuit Court of the United States for the District of Connecticut, Judge William K. Townsend has just handed down an interlocutory decree in the case of the suit brought by the National Conduit Manufacturing Company against the Connecticut Pipe Manufacturing Company. This case was brought by the National Conduit Manufacturing Company against the defendant company for infringements of patents on the well-known cement-lined iron pipes for electrical subways, all of the patents on which are owned by the plaintiff company. The patents in question cover broadly the use of cement-lined iron pipes for electrical subways. The decision in favor of the National Conduit Manufacturing Company enjoins the defendant company perpetually from the manufacture, sale or use of such cement-lined pipe, and the construction of such subways. The decree further orders that the defendant must compensate the plaintiff for all profits gains or advantages which it has obtained by reason of all infringements heretofore, and appoints a referee, with full power, to examine into the business of the defendant to ascertain and assess the amount of damages. The National Conduit Manufacturing Company is now proceeding against the receiver of the defendant company, in order to get damages for the infringements in question, in accordance with the decree of court above mentioned, and prevent him from disposing of the pipe, etc., which came into his possession under the receivership.

Personal Notes.

DR. LOUIS DUNCAN, of Johns Hopkins University, Baltimore, Md., has been engaged as consulting engineer of the Third Avenue Railroad Company, of New York City.

MR. JAMES I. AYER, general manager of the American Electric Heating Corporation, Boston, was in New York on business during the week. Mr. Ayer is always a welcome visitor to the metropolis.

Obituary Note.

J. H. RHOTEHAMEL.—The readers of The Electrical World will be pained to learn of the sudden death in St. Louis, Mo., on February 17, of Mr. J. H. Rhotehamel, president of the Columbia Incandescent Lamp Company, of that city. Mr. Rhotehamel was born in Miami County, Ohio, on October 20, 1857, and was, consequently, a little more than forty years of age. His early education was obtained in a country school, after which he went to Antioch College, at Yellow Springs, Ohio. He subsequently taught school and afterward engaged in the real estate business, in which he continued until he entered the more promising electrical field. Mr. Rhotehamel went to St. Louis in July, 1889, and organized the Columbia Incandescent Lamp Company, which concern became prosperous through his individual efforts. Mr. Rhotehamel was a persistent and active worker. When he laid down a line of action he stuck to it in spite of every obstacle. This trait of character was abundantly demonstrated in connection with the historic Goebel lamp contest in 1893. He investigated the Goebel matter very carefully and, being satisfied that the claims were well founded, decided to defend them. Mr. Rhotehamel fought the case with a persistency that challenged the admiration of all, and he had such faith that he was in the right that he never wavered in his determination to secure the justice that he conceived to be due to Goebel. The fight was practically single-handed, however, and the result is now a matter of history. Mr. Rhotehamel's course in this suit furnishes an excellent example of confidence, persistence and fortitude. The decision of the court was against him, but he had a certain satisfaction in the knowledge that he fought valiantly in a just cause, and that the fight was lost, not by any lack of interest or effort on his part, but by the overwhelming odds that were set against him. Mr. Rhotehamel had a very large circle of acquaintances, all of whom will mourn his loss. He possessed personal charms of nature and manner which drew to him many friends, and in his death the electrical fraternity suffers a distinct loss.

J. H. Rhotehamel.

Trade and Industrial Notes.

MESSRS. WARREN WEBSTER & CO., Camden, N. J., have since December last received contracts for twenty-three installations of the Webster system of steam heating, among them being an equipment for the J. G. Brill Company, of Philadelphia, the well-known car building concern.

MESSRS. G. M. ANGIER & CO., Boston, Mass., state that a great many central station managers are making inquiries regarding the Paragon arc lamp for series arc circuits. These lamps burn 100 hours with one trimming, and are particularly adapted for use on commercial and street circuits where six and a half ampere lamps are required. The firm will be glad to give all the information desired by anyone interested.

THE COMPLETE WIRING SYSTEM, as established and standardized by the Interior Conduit & Insulation Company, will be installed exclusively in the new Park Row building, New York, the largest office building in the world. Some 250,000 feet of interior conduit will be used in the installation, which will be made by the New York Electric Equipment Company. Sprague high speed vertical electrical elevators will also be used in this building.

MESSRS. STANLEY & PATTERSON, 32 and 34 Frankfort Street, New York, are now manufacturing a line of first-class long distance telephones. These instruments are guaranteed to give entire satisfaction in general exchange work and on private and long distance lines. The diamond grain carbon is used in the manufacture of the transmitters, and is imported and prepared by the firm. The Stanley carbon battery is employed in the operation of this telephone. The instrument in every part is made of the very best material.

"EXPERIENCE, NOT EXPERIMENT" is the title of a pamphlet issued by the Goheen Manufacturing Company, Canton, Ohio, explaining the company's process of protecting iron and steel. The company some years ago introduced its "carbonizing coating," which is claimed to be the only chemically combined paint made for iron and steel. It is made expressly for one purpose, viz., protecting metals, and it is said to be the most economical and perfect coating known for the preservation of iron and steel from rust, corrosion and decay. The carbonizing coating, it is stated, is not affected by acids, alkalies, brine, sulphur fumes or locomotive smoke. Several testimonials refer in a very complimentary manner to the carbonizing coating.

MR. W. R. GARTON, whose name has so long been familiar in the electrical trade, has fitted up a handsome office at 414 Ashland Block, Chicago. Mr. Garton represents the Garton-Daniels Electric Company, Pittsburg Steel Holloware Company, Massachusetts Chemical Company and other Eastern manufacturers. He will also sell the Billings & Spencer drop forge commutator bars and electric railway supplies in general, but will not give attention to minor supplies or repair parts. Mr. Garton has just been elected general manager of the Garton-Daniels Electric Company. He is also a stockholder and the consulting engineer of the Raster Carbon Rheostat Company, and with these different though not conflicting interests to look after ought to find enough to do to keep him out of mischief.

THE C & C ELECTRIC COMPANY, New York, reports that it has never before experienced a busier season than it has enjoyed during the last six months. During this time its factory has been operated to the fullest capacity, both night and day, and orders are coming in from all quarters. The demand includes machines of all types and sizes manufactured by this company. The February business was particularly good with the company, many of the orders received during that month being very desirable ones and landed in the face of keen competition. The C & C Company expects to make a very interesting exhibit of its new types of apparatus at the Electrical Exhibition, which will be held at Madison Square Garden in this city during the month of May. Among the direct-connected generators to be shown in operation will be one driven by a Diesel Rational heat motor, the first to be exhibited in this country. This new type of engine is creating favorable comment in Europe.

THE NIAGARA CARBON COMPANY, North Tonawanda, N. Y., is the latest candidate for orders for high grade electric light carbons. The company occupies the old Boulton carbon works and has been doing business for several months. The present facilities are really taxed to keep up with the orders. It is the intention, however, to build an addition to the works. Mr. August Lippert, who for twelve years was connected with one of the well known carbon manufacturing concerns in Germany; Mr. August Heldebrand, who was also engaged in the same business in Europe, with Mr. Cecil L. Saunders, who for a number of years was engineer with the National Carbon Company, of Cleveland, and who designed and superintended the building of a part of the National Carbon Company's works, comprise the personnel of the Niagara Carbon Company. Thus far the company has confined its output to high grade carbons for use in enclosed arc lamps, and claims that it can make a carbon of as good quality as the imported.

MESSRS. MACHADO & ROLLER, 203 Broadway, New York, report a marked increase in the amount of business being done by them. The A. E. G. lamps are proving excellent sellers. The firm states that it still has left a few of the booklets describing the manufacture of these lamps, and will be glad to send copies to interested persons. They invite inquiries regarding their high voltage lamps, which they are selling in candle powers of from 10 to 50. These lamps will burn in any position, and are guaranteed to have an average life of 800 hours. Whitney instruments are also being disposed of in greater quantities than ever before, and the new line of switchboards and of portable combination, direct and alternating-current instruments, is becoming popular. F. Hardtmuth & Co., of Vienna and Ratibor, whom Messrs. Machado & Roller represent, have recently brought out a line of special carbons of exceptionally high grade, suitable for use in enclosed lamps to burn on both direct and alternating current. The cored type of carbons of this style is said to be particularly fine.

THE WARD LEONARD ELECTRIC COMPANY, Bronxville, N. Y., has just issued its tenth catalogue, which is devoted to outlet boxes. The list includes bracket boxes, ceiling boxes, cornice boxes, boxes for ceiling rosettes, circular loom, flexible cord, and every other class of box used in electrical

work. These various boxes are illustrated. They are finished in porcelain enamel or black japan. The company carries a large stock of all sizes of these outlet boxes and can generally make prompt shipment from stock. It has exceptional facilities for making special boxes. During the year 1897 81,000 porcelain lined outlet boxes manufactured by the Ward Leonard Electric Company were installed in New York City alone. By means of this special enamel the contents of the outlet boxes can be permanently insulated from the cast iron of the box, and hence from the building, so as to withstand 2000 volts alternating, and, if necessary, the insulation may be vastly increased by a slightly increased thickness of the enamel, although the amount named is usually enough.

INTERNATIONAL CORRESPONDENCE SCHOOLS.—That technical instruction by means of correspondence is an unqualified success needs no better demonstration than is afforded by the International Correspondence Schools, of Scranton, Pa. From a small beginning seven years ago it has grown to such an extent that its present membership aggregates upwards of 32,000. To facilitate the work of enrollments the school has recently opened well-appointed offices in Boston, New York, Philadelphia, Pittsburg, Cleveland, Cincinnati, St. Louis and Chicago. These branch offices are only for the enrollment of students. The instruction will as heretofore be given direct from headquarters at Scranton. The Chicago offices are situated on the second floor of the Monadnock Block, Rooms Nos. 202 to 207, and students who are already enrolled, as well as prospective students, will be welcomed there. The magnitude and scope of the work of the school may be appreciated to some extent when it is stated that something like forty different courses are taught, including mechanics and mechanical drawing, electricity in all its varied applications, architectural drawing, plumbing, heating and ventilation, steam engineering, etc,, etc.

Business Notice.

DO YOU WANT A GOOD FARM for very little money?—We can put you in the way of getting fine farm lands in South Dakota for $10 per acre and upward, one-third cash, balance on easy terms. Send for descriptive list of lands and for free illustrated pamphlet on South Dakota containing numerous letters from farmers in the finest agricultural and stock-growing Western State. Address George H. Heafford, General Passenger Agent Chicago, Milwaukee, and St. Paul Ry., Old Colony Building, Chicago, Ill., or H. F. Hunter, Immigration Agent, 291 Dearborn Street, Chicago, Ill.

Illustrated Record of Electrical Patents

UNITED STATES PATENTS, ISSUED FEBRUARY 15, 1898.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

598,922. AUTOMATIC CUT-OUT FOR ELECTRICAL CONVERTERS; W. J. Greene, Cedar Rapids, Ia. App. filed Jan. 13, 1896. In a cut-out for electrical converters, the combination with a suitable supporting frame, of a pair of solenoids oppositely inclined to each other, means for alternately energizing them, a switch arm adapted to close and break the primary and secondary circuits, with a curved armature attached to its free end and coacting with said solenoids, a pair of solenoid switches and a connection between them adapted to throw one open when the other is closed, and a projection on said switch arm adapted to engage said solenoid switches alternately when near the limit of its stroke.

598,926. BOX OR CASE FOR SECONDARY BATTERY ELECTRODES; G. W. Harris and R. J. Holland, New York. App. filed Sept. 3, 1896. A box or case for the reception of electrodes of secondary or storage batteries, formed of insulating material, and provided interiorly on its opposite sides with ribs which are integral with said sides and between which ribs are grooved for the reception of the ends of said electrodes, so that the latter will be held separated from each other, said ribs running uninterruptedly to the height of the electrodes to be received between them so that buckling of said electrodes will be effectively prevented, and the said grooves having a special lining of insulating material, and terminating at their bottom in shoulders.

598,937. TROLLEY; C. H. Johnston, Elmhurst, Cal. App. filed Oct. 24, 1896. A trolley, consisting of a trolley wheel carried by a pole, a crank arm also carried by said pole, said crank arm having a forked end, and a roll also carried by the pole with which the formed end of one trolley may engage for the bridging of another trolley to the opposite side of the first-named trolley.

598,940. FUSIBLE CUT-OUT; J. Jones, Jr., Brooklyn, N. Y. App. filed March 12, 1897. A base of insulating material having rubbed edges, in combination with conductors and screws for permanently connecting the conductors to the base, two spring electrodes or terminals clamped to the conductors, and a fusible strip received between the electrodes and the base, and a cover engaging the slide ribs on the base, and acting on the spring terminals to press them against the strip of fusible material, such springs also applying friction to prevent the cover sliding on the base.

598,942. ELECTRIC ARC LAMP; G. R. Lean, Cleveland, Ohio. App. filed Feb. 20, 1897. The combination in an electric arm lamp constructed to operate with alternating electric currents, of a starting coil, a feeding coil, the feeding coil included in series with the starting coil, an armature for each coil, said armature being normally so disposed relatively to the magnetic fields of the respective coils that the armature of the starting coil will be actuated in advance of the armature of the feeding coil, devices connecting said armatures and connections between one of said armatures and the carbons of the lamp.

598,943. ELECTRIC ARC LAMP; G. R. Lean, Cleveland, Ohio. App. filed Feb. 20, 1897. In an electric arc lamp, the combination with the upper and lower carbons and regulating mechanism for feeding both carbons simultaneously, of an arc, including globe constructed with contracted openings at its opposite ends, said openings being of such size as will cause the carbons to snugly fit within the walls of each opening, and means for supporting the globe which will permit its opposite ends to move laterally and compensate for irregularities of the carbons.

598,946. DIRECT-ACTING OSCILLATING ELECTRIC MOTOR; J. H. Mason, Brooklyn, N. Y. App. filed March 24, 1897. A direct-acting oscillating electric motor, comprising field magnets having forwardly extending arms projecting at right angles to the axes of their coils, means for energizing the said field magnets, an armature, comprising a plurality of radially extending arms mounted to rock back and forth between the projecting arms of the field magnets, said arms being provided with coils, means for maintaining a constant current through the coils of the armature, and means for changing the polarity of the field magnets.

598,947. TRACK BOND FOR ELECTRIC RAILWAYS; F. T. Mather, Detroit, Mich. App. filed June 29, 1896. In a track bond for electric railways, the combination with the rails of the track having a lateral tread and provided with a continuous groove running longitudinally of the treat, the rails of the track having square ends, which are placed together so as to form a tight joint, the groove in the flange of said rails passing entirely through said flange adjacent to the ends of the rail sections, the electrical conductor in said groove extending the entire length of the track, said conductors at the junction of the rail sections having a loop which depends through the opening cut through the flange of the rail.

598,948. ELECTRIC BATTERY FOR MEDICAL PURPOSES; C. W. Moessner, Philadelphia, Pa. App. filed June 2, 1896. In a medical battery, a rheostat for controlling the electric currents composed of a series of alternately arranged metallic and composition members, the metallic members being each composed of a series of metallic strips and provided with contacts, and a movable switch adapted to be moved over the contacts.

598,972. TIP FOR ELECTRIC CONDUCTORS; A. B. Blodgett, Lowell, Mass. App. filed Dec. 22, 1896. An electric conductor, comprising a conducting core, a non-conducting covering and a conducting needle, having a tranverse hole, and a fastening passed through said hole to retain said needle in said covering.

598,991. CONTROLLER FOR ELECTRIC MOTORS. E. W. G. C. Hoffmann, Charlottenburg, Germany. App. filed Dec. 29, 1897. The combination in a controller for electrical apparatus, with a controller part having suitable contact parts connected therewith for effecting the necessary circuit changes, of a rheostat, a part controlling the resistance of said rheostat connected in circuit and means for automatically cutting a predetermined amount of resistance into circuit when the movement of said part is effected.

599,002. INCANDESCENT LAMP; J. T. Lister, Cleveland, Ohio. App. filed Oct. 14, 1896. In an incandescent lamp, the combination with annularly recessed extremities of the shell, of a cylindrical cap therefor adapted to fit interchangeably over either extremity, a pair of filament electrodes extending through each shell extremity, corresponding electrodes adapted to engage the pair of filament electrodes when the lamp is in place, and means for securing the cap upon the shell extremity, consisting of a wire spring, partially encircling the cap, and provided with inwardly turned extremities, which pass through the wall of the cap and enter the annular recess in the shell.

599, 014. ENGINE STOP; J. R. and F. P. Reynolds, Hartford, Conn. App. filed May 29, 1897. In an engine stop, in combination, a spindle adapted to be connected with the throttle controlling the engine energizing fluid, means for rotating the spindle, a catch for temporarily retaining the spindle with the rotating means under tension, a trip for moving the catch, mechanisms for releasing the trip, intermeshing differential gears and pinions that are rotated and revolved by the rotation of the spindle, and a retarding plunger and cylinder brought into action by the movement of the gears and pinions.

599,015. ELECTRIC ELEVATOR; H. Rowntree, Chicago, Ill. App. filed Feb. 28, 1896. The combination with a main motor, of an auxiliary motor, means for controlling said auxiliary motor, and means operated by the joint action of the speed of said main and auxiliary motors for controlling said main motor.

599,032. ELECTRIC ARC LAMP; C. N. Black, New Haven, Conn. App. filed April 20, 1897. In an arc lamp, a pivotally supported armature carrying a plunger, a dash pot loosely supported from above in which said plunger works.

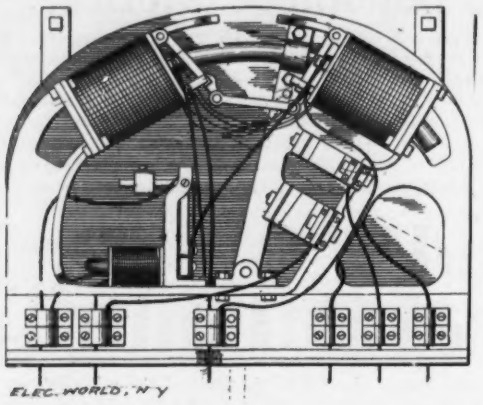
599,046. ELECTRIC METER; C. Raab, Kaiserslautern, Germany. App. filed Feb. 27, 1896. An electric meter having a disc armature and two coreless solenoids placed on opposite sides of said disc and in inductive proximity thereto, in combination with two electromagnets located also on opposite sides of the disc and having pole pieces extending into close proximity thereto, and solenoids being located in the circuit to be measured and the electromagnets in a shunt circuit thereto.

599,081. INSULATED JOINT FOR RAILROAD RAILS; T. O'Brien, Jr., Philadelphia, Pa. App. filed June 4, 1897. In an insulated railroad joint, a cross tie of non-conducting material, a metallic plate seated on said cross tie having a recess formed in its upper face near an end thereof, an insulating block seated in said recess and substantially surrounded by the walls thereof, and held thereby against accidental displacement, a rail having an end resting on the non-recessed end of said metallic plate, a rail having an end resting on said insulating block, and insulation interposed between the ends of said rails.

599,094. TRANSFORMING POTENTIAL ENERGY OF CARBON INTO ELECTRICAL ENERGY; H. Blumenberg, Jr., New York, N. Y. App. filed April 7, 1896. An improvement in the art for converting potential

energy of carbon or carbonaceous material or compounds into electrical energy, which consists in chemically combining carbon and oxygen by injecting steam through an interposed electrolyte, consisting of a fused bath composed of one or more of the fusible salts of the alkali metals or alkali earth metals, and an added oxidizing agent.

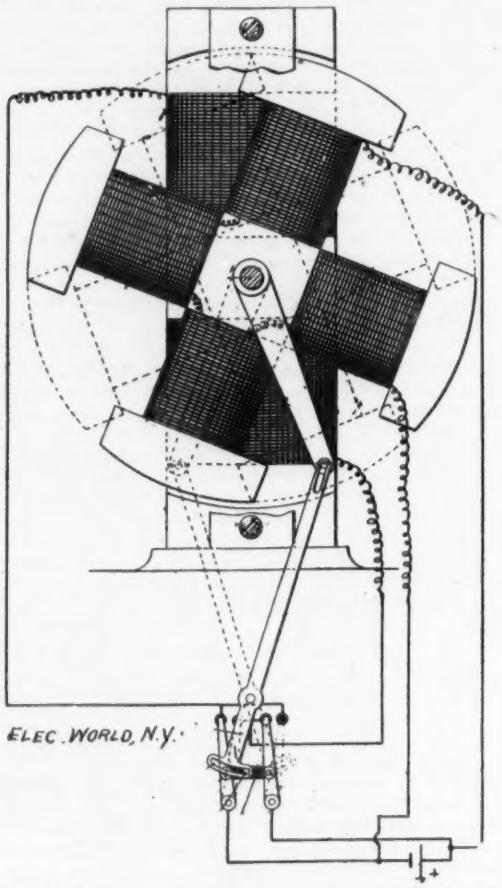
599,121. ELECTRIC GAS LIGHTING APPARATUS; W. E. Cram and J. H. L. Clegg, Boston, Mass. App. filed April 30, 1897. The combination with a gas burner and cock, of a switch operated by the movement of said cock



No. 598,922.—Automatic Cut-Out for Electrical Converters.

for making and breaking an electric circuit, an electromagnet arranged in said circuit, and having a vibratile armature provided with a contact member arranged in proximity to the orifice of the gas burner, and a thermostat arranged in said circuit and adapted to co-act with the vibratile member in causing a series of gas igniting sparks, and to be expanded by the heat of the gas flame, so as to separate the sparking points to break the electric circuit at the point of sparking, and to keep them separated during the existence of a flame.

599,162. ELECTRIC SYSTEM OF PROPULSION; W. M. Brown, Johnstown, Pa. App. filed May 18, 1897. The combination in an electric railway,



No. 598,946.—Direcp-Acting Oscillating Electric Motor.

of main feeders in sections, detachable connections between adjacent ends of the feeder sections, groups of disconnected contacts corresponding in number to that of the said feeder sections, and sub-feeders connecting the individual members of each group, with the connected ends of one pair of the feeder sections.

599,186. ELECTRIC CONTROLLER; F. A. Merrick, Auburndale, Mass. App. filed May 27, 1897. In an electric controller, having stationary contacts connected to various parts of the circuit, and movable contacts co-operating therewith, the combination with one of the stationary contacts connected to one side of the circuit through the energizing coil of an arc interrupter, co-operating movable contacts engaging therewith at all operating positions of the controller, another of the stationary contacts connected directly to the same side of the circuit, and co-operating movable contacts engaging therewith at certain positions of the controller only.

599,220. ELECTRICAL ALARM WATER COLUMN; M. L. Bush, Lawrence, Mass. App. filed June 14, 1897. The combination in an electric alarm water cylinder having boiler connections, of a float in said cylinder, a tube and rod connected with said cylinder insulated from each other, and carrying arms adapted to be engaged by said float, means for vertically adjusting said arms, and the wires and battery connections whereby the alarm is sounded when the float contacts with said arms.

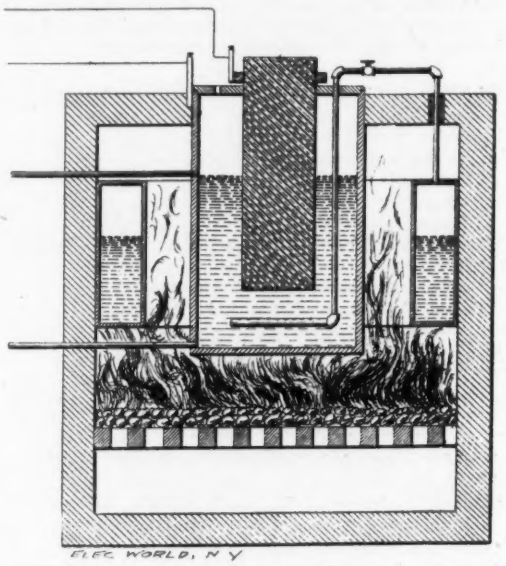
599,274. TROLLEY POLE FOR OVERHEAD ELECTRIC RAILWAYS; J L. Walker, Louisville, Ky. App. filed June 18, 1897. A trolley pole having its members pivoted one to the other to lie in alignment under normal conditions, one member carrying the trolley wheel, combined with a latch which connects two of the pole members, a draw-bolt connecting the intermediate pole member and the wheel-carrying member, and operative connections between said draw-bolt and the latch.

599,292. UNDERGROUND CONDUIT FOR ELECTRIC WIRES; A. L. Daniels, North East, Pa. App. filed Dec. 22, 1897. An improved conduit for underground electric wires, consisting of sections having a metal case with ends of insulating material of less internal diameter than the case, the ends of adjacent sections conformed to fit together, and a lining of insulating material connecting said ends.

599,302. DIRECT-CURRENT METER; G. A. Scheeffer, Peoria, Ill. App. filed May 7, 1896. In an electric meter the combination with field-coils connected with the circuit to be measured, of an armature adapted to be actuated thereby, which is connected with said circuit with the field-coils to receive current passing through said coils sufficient to supply a torque thereto adapted to overcome the initial friction of the rotating parts.

599,304. DEMAGNETIZING DEVICE; H. A. Storrs, Burlington, Vt. App. filed June 18, 1896. In electro magnet having overhanging poles and adapted to produce an alternating magnetic field, a rotable carrier for the object to be demagnetized, having a fixed axis and adapted to move said object slowly between the poles of the magnet, and a shield interposed between the lower pole of the magnet and the object, to prevent contact of the latter with the pole.

599,305. ELECTRIC ARC LAMP; C. Tepel, Bennett, Pa. App. filed March 10, 1897. In an electric arc lamp the combination with carbon-holders movable toward and from each other, of a pulley, suitable connections between the same and the carbon holders, respectively, for producing opposite movements of the latter by the turning of the pulley, a clutch wheel fast with the pulley, a lever pivoted concentric with the clutch wheel, a dog pivoted to one end of the said lever and arranged to engage the periph-



No. 599,094.—Transforming Potential Energy of Carbon into Electrical Energy.

ery of the clutch wheel an abutment for said dog to encounter under one direction of movement of the lever to free said dog from its wheel, an air cushion on the same arm of the lever, an electro magnet in the lamp circuit and a core in said magnet connected with the opposite side of the lever.

599,306. MAKING FILAMENTS FOR ELECTRIC LIGHTING; D. C. Voss, Boston, Mass. App. filed Aug. 3, 1891. A filament for electric lighting built up and composed from aluminum and iodin.

599,307. TROLLEY ACTUATED SWITCH OPERATING DEVICE FOR ELECTRIC RAILWAYS; L. E. Walker, Springfield, Mass. App. filed Aug. 18, 1897. In a "third-rail" electric railway system in combination the usual side-track rails, the intermediate third rail current-conductor section and a length of insulating material between the adjacent third rail and the under running shoe or trolley which is shorter than said length of insulating material, said section and length being adapted to receive alike the running impact of the under running shoe or trolley, and said insulating length having a recess or aperture therein, a depression member located in said aperture, having its upper edge normally above the tread surface of said insulating material, and an electric switch operated by the movement of said depression member.